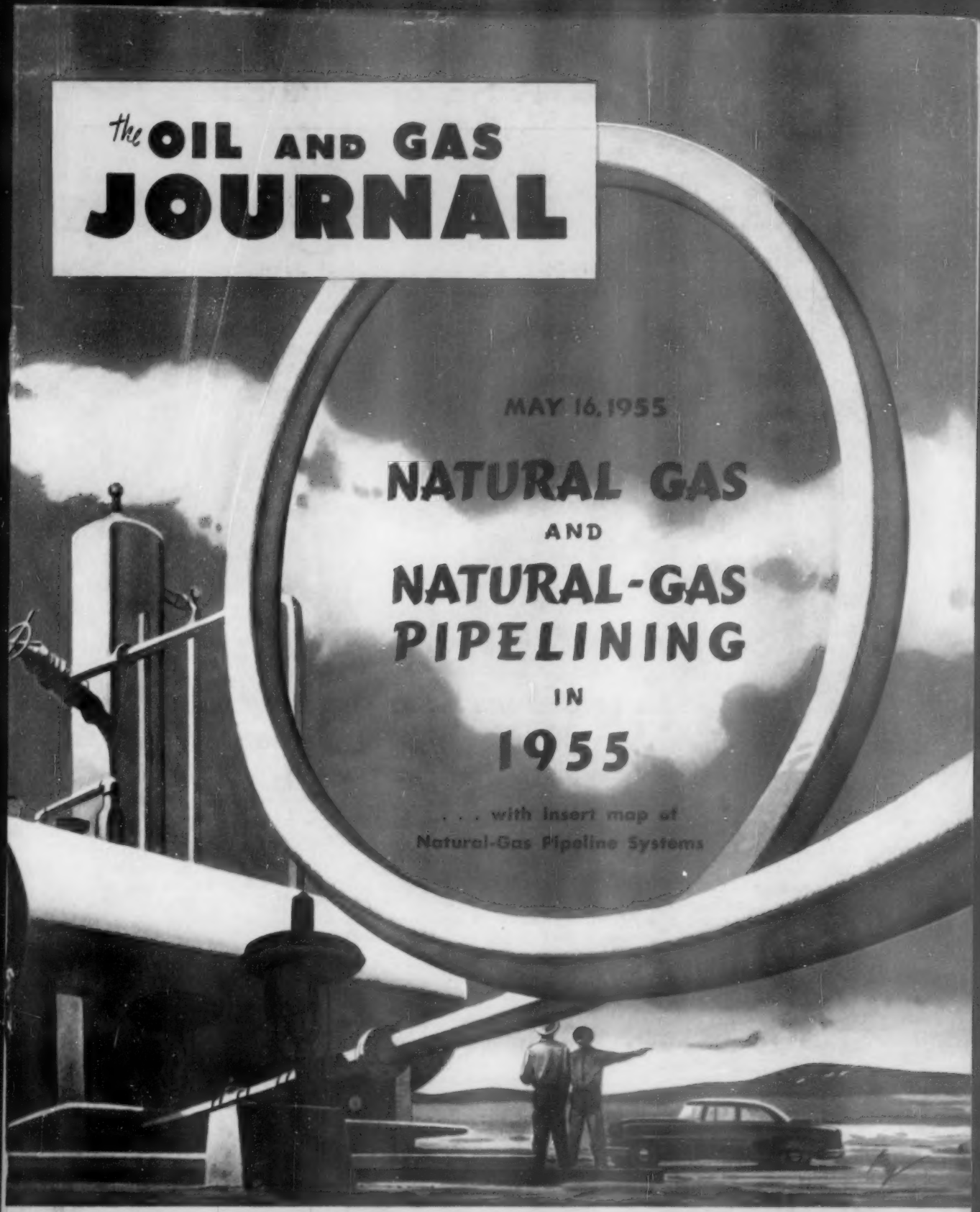
the OIL AND GAS JOURNAL



MAY 16, 1955

NATURAL GAS AND NATURAL-GAS PIPELINING IN 1955

. . . with insert map of Natural-Gas Pipeline Systems

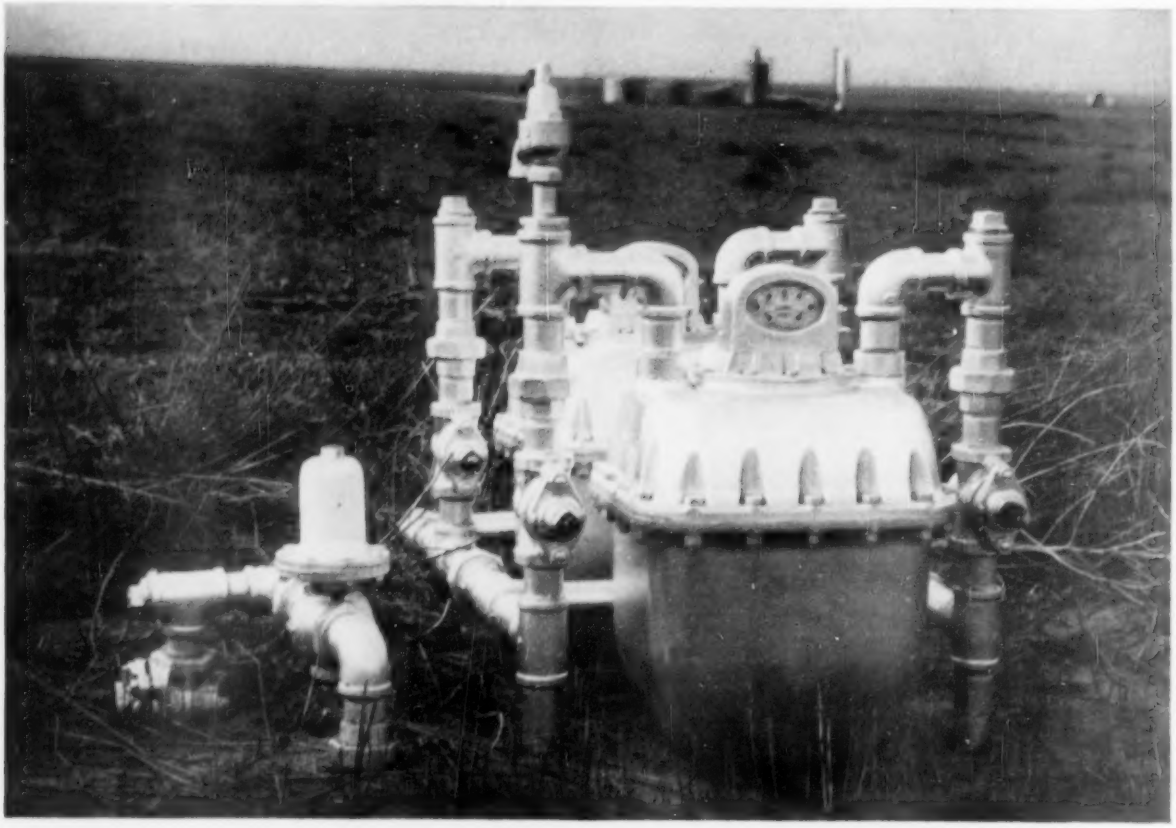
UNDERGROUND GAS STORAGE . . .

. . Nearing 2 trillion feet and increasing • P. 118

A.P.I. REFINING DIVISION MEETS . . .

News coverage of outstanding papers • P. 126

For Field, Farm or Factory



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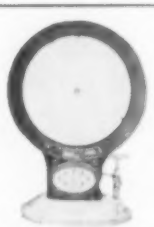

PAGE 1 ONE . . . *a glance ahead*

Look for foreign activity to increase in many spots around the world. Countries are becoming more conscious of their oil-producing possibilities, are making conditions more attractive for oil investment. Smaller U. S. oil companies are developing symptoms of foreign-exploration fever.

Some refineries are entering era of intense specialization to survive against huge complete plants. Trend is growing toward concentration on specialty products, custom processing, and interchange of semifinished products among plants for greater efficiency.

Eastern Montana will have big increase in wildcatting and producing activity following completion of crude pipeline this year. This end of Williston basin likely will take the play away from the North Dakota portion during next couple of years.

L.P.G. storage in excavations in sandstone and other porous rocks is made possible by newly developed neoprene-silicone resin sealant sprayed on cavity walls. First field trials look practical, economical. May greatly increase storage near consuming centers.

Growing use of alkylate in motor fuel raises fears among some refiners that Government may restore restrictions on alkylate use if bids for military aviation gasoline are unsatisfactory. Such a move would catch many refiners with their octanes down.

Jet-fuel purchases by U. S. military will average 255,000 bbl. per day next fiscal year—almost twice as much as avgas purchases and equal to total of avgas, motor gas, diesel, and lube purchases combined. Jet fuel is only military petroleum purchase to have significant increase over last year; motor gas and fuel oil will decline.

The OIL AND GAS JOURNAL

MAY 16, 1955 • VOLUME 54 • NUMBER 2

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EXPLORATION • DRILLING • PRODUCTION • FIELD PROCESSING

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NATURAL GAS—NATURAL-GAS PIPELINE ISSUE

Gas Girds to Fend Off Federal Control 140
By Dahl M. Duff

Few other industries in the country have shown the phenomenal rate of growth that has become commonplace with natural gas since the end of World War II. The industry continued to make sharp gains last year but its long-term future is clouded by federal regulation of the producing side of the business

Speed Up Flow Calculations for Gas-Gathering Systems 148
By Ovid Baker and Will Swerdloff

Here is a simple, accurate method for making gas-flow calculations. It applies equally well to transmission lines and gathering systems. It gives an exact solution to the general flow equation of the U. S. Bureau of Standards Monograph 6. Yet it can be used as rapidly as specialized forms.

295-Mile Looping Program Completed 164
By S. A. Bergman

Panhandle Eastern Pipeline completed its third main line from Kansas through Ohio and laid extensions in Michigan during the last quarter of 1954.

United Gas Pipe Line Reduced Compressor-Station Noise 168
By C. S. Kenworthy

First step in the noise abatement was the installation of an eliptical baffle in front of the air filter screen exhaust-manifold and the inside walls and roof of the main building were insulated. Truncated cones were used on exhaust and intake piping. Gear and pump noises were reduced.

Drilling Problems are Rugged in the San Juan Basin 176
By W. W. Mize

The location of the basin with its isolation and rugged terrain has given rise to some of the toughest problems the industry has ever had to face. Special equipment and methods have been developed to insure efficient operation.

Why Corrosion in M.E.A. Gas-Treating Plants? 180
By L. D. Polderman, C. P. Dillon, and A. B. Steel

Many gas-treating plants operate for long periods without undue difficulties. But some plants have serious corrosion problems. In these plants the monoethanolamine is converted to degradation compounds which do not accept acid gases.

Packaged Compressor Plants Have Come of Age 184
By J. M. Lane

This equipment can do an excellent job at a relatively low installed cost and it has unusually high salvage value.

Permian Basin Plant Designed for Water Conservation 187
By R. B. McLaughlin and A. B. Richert

Permian Basin Pipe Lines' Hobbs, N. M., processing plant uses air-finned cooling equipment to conserve water.

TECHNOLOGY—OPERATION

Tight Folds Should Harbor More Than One Oil Trap 192
By Norman S. Morrisey and Jack L. Walper

Several fault blocks can develop on a fold formed by horizontal compression under favorable conditions. Oil may occur in any or all of these fault blocks.

Upgrading Crudes and Residues 196
By Jerry McAfee, C. W. Montgomery, C. R. Sommers, Jr., J. V. Misch, and W. A. Horne

The Gulf HDS process is a moderate-pressure process which converts catalytically heavy residual fractions to lower-boiling distillate products.

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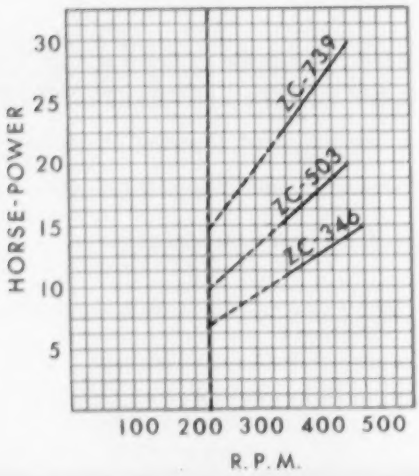

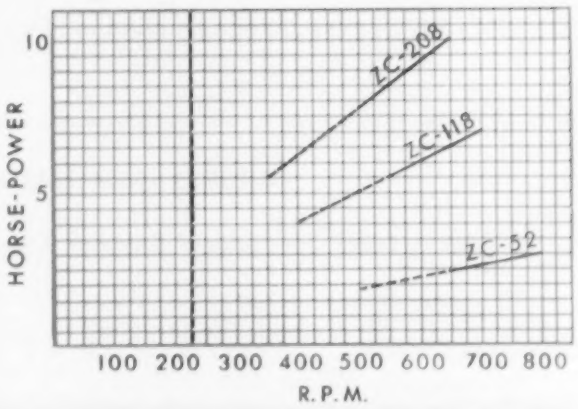

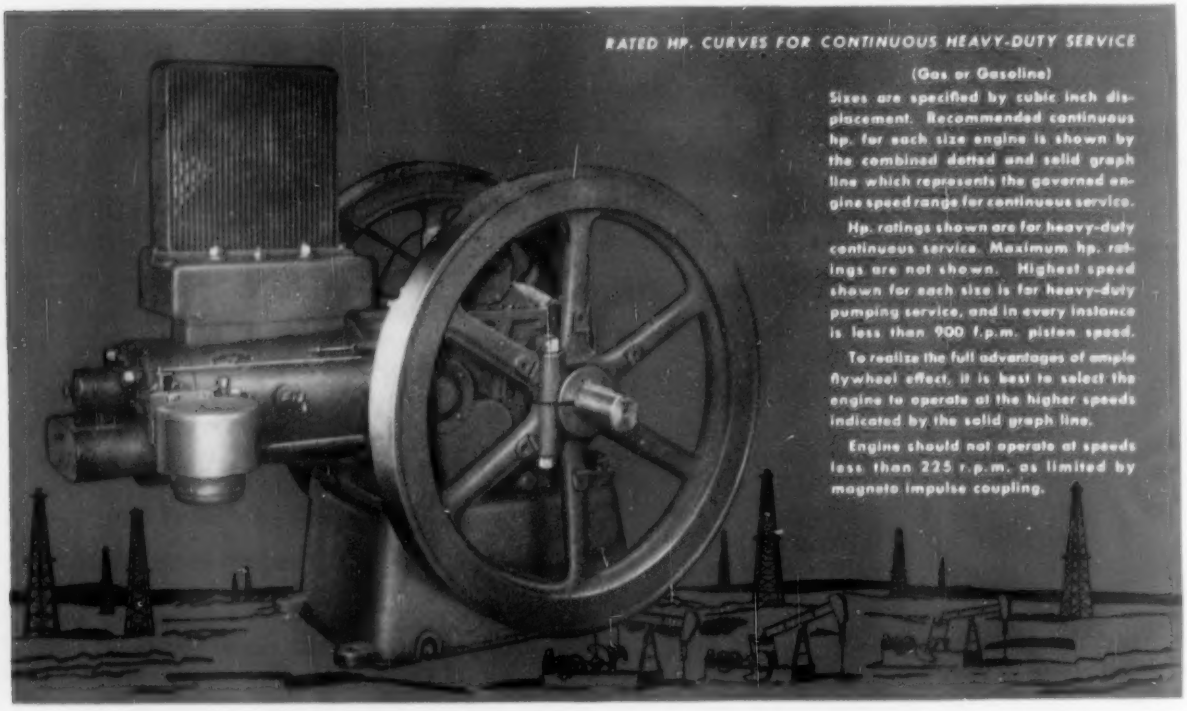
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DU PONT LUBE OIL ADDITIVE 565 has a higher molecular weight than Lube Oil Additive 564 for greater viscosity index improvement.

Form no sludge

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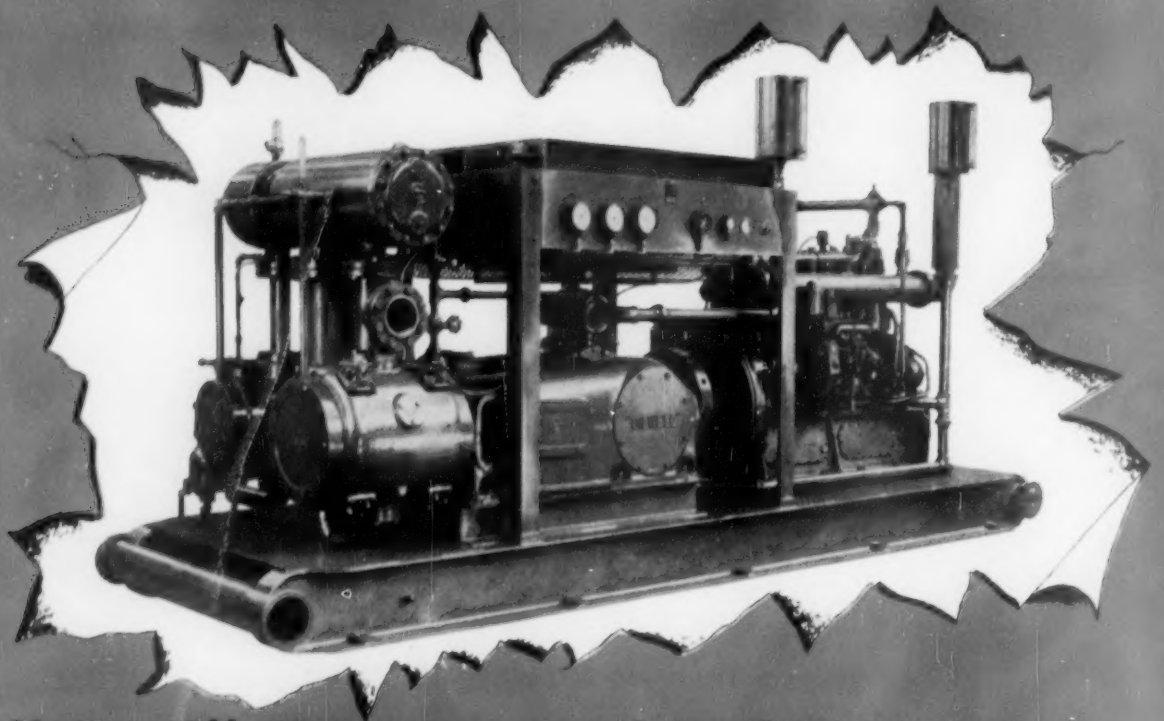

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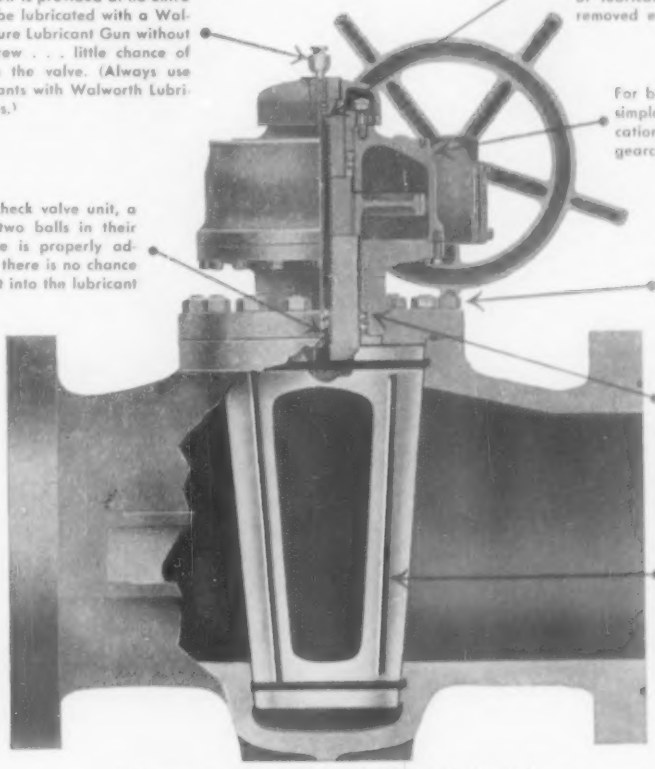
An added safety feature in the form of a groove cut part way up side of the lubricant-fitting screw allows the operator to observe any tendency of lubricant to blow out before the screw is removed entirely.

For buried pipelines — yoke design permits simple attachment of handwheel and lubrication extensions without modifying the gearcase.

In the stainless steel check valve unit, a transverse pin holds two balls in their seats. When the valve is properly adjusted and lubricated, there is no chance for line pressure to get into the lubricant system.

Standard bolt threads, rather than fine threads, mean easy replacement of nuts and bolts from local stocks.



Two overlapping Teflon packing rings form an effective seal against possible leakage without "grabbing" the plug shank. Low breakout torque . . . plug turns easier. Packing serves only as a seal and is not used to hold the plug in its seat.

Lubricant grooves completely frame the port openings and encircle the plug at the top and bottom assuring a tight seal against leaks. Bottom circumferential groove is separate from, but connected with, the lubricant well.

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Cutaway of a 24-inch Walworth Lubricated Plug Valve

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B.t.u.'s valuable enough to warrant a "plant" investment aggregating more than a billion dollars to transport them half way across a continent are too valuable not to be counted accurately. Because this is true and because return on this huge investment demands such accurate count, the great transcontinental natural gas pipe lines use Cutler-Hammer Calorimeters at gathering points in the southwest and distribution points in the rich industrial and domestic markets of the east. These Calorimeters are the *only instruments* that establish conclusively the B.t.u. count per cubic foot of gas flow in and gas flow out.

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A PARTIAL LIST

of natural gas pipe lines using C-H Calorimeters and municipalities using B.t.u. metering and mixing equipment in the distribution, mixing and sale of natural gas.

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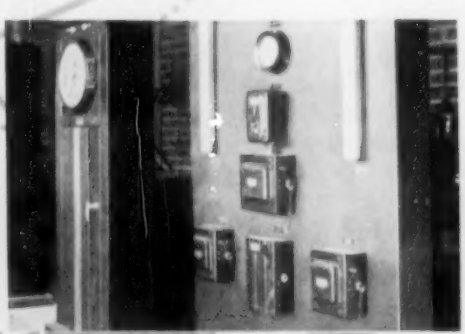
Northern Natural Gas Co.
Panhandle Eastern Pipe Line Co.
Southern Natural Gas Co.
Tennessee Gas Transmission Co.
Texas Eastern Transmission Corp.
Texas-Illinois Natural Gas Co.
Transcontinental Gas Pipe Line Corp.

Brooklyn	Evansville	Philadelphia
Chicago	Milwaukee	Pittsburgh
Detroit	New York	Etc., etc., etc.

And the Municipal Utilities served use Cutler-Hammer Calorimeters to check, and Cutler-Hammer Gas Mixing Equipment to stabilize, the heating value of the gas distributed.

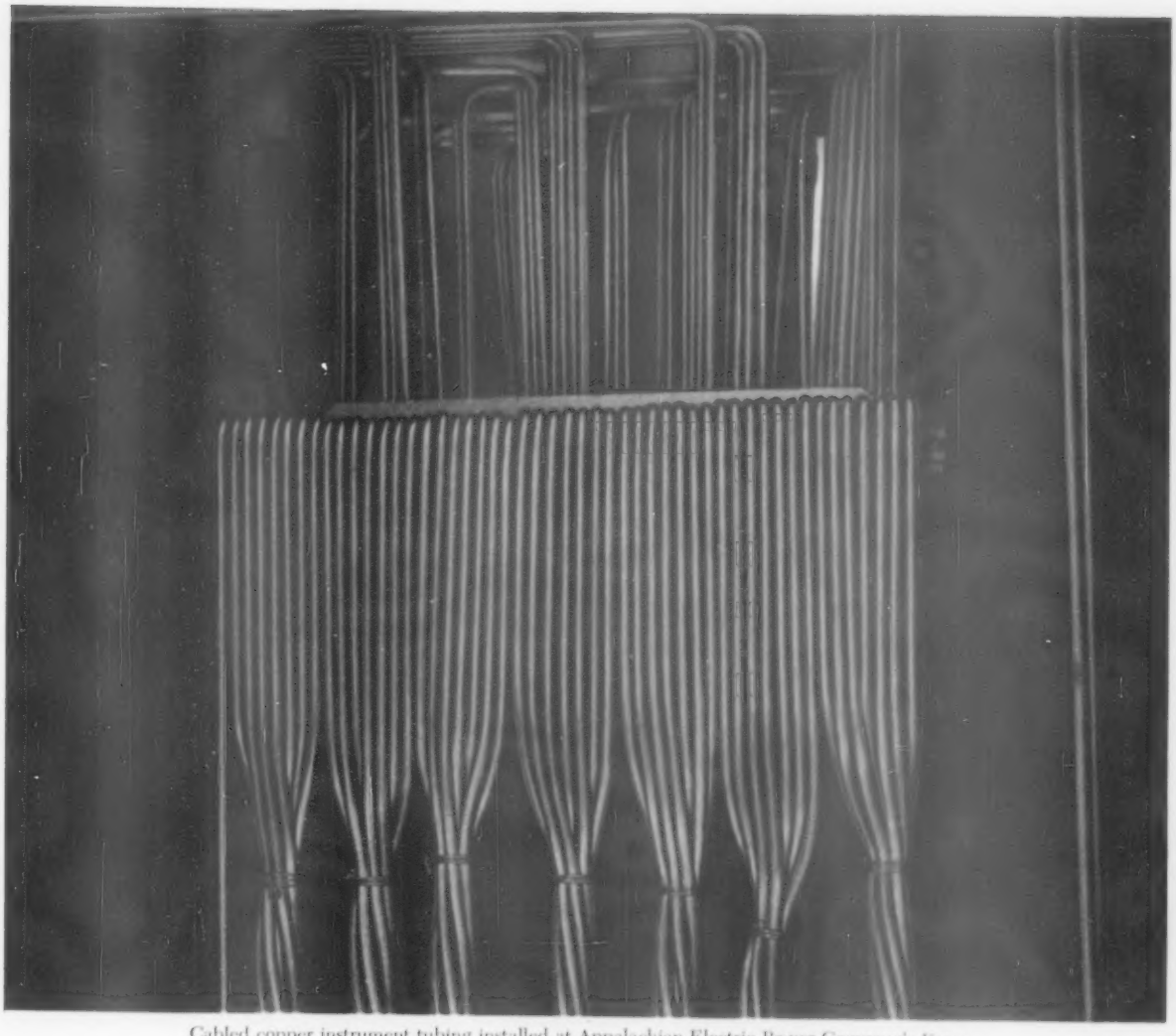


C-H Calorimeters *(at left)* measure accurately and uncompromisingly the B.t.u. content of each unit volume of gas distributed regardless of temperature, pressure or flow variables, and write a continuous available record.

C-H Calorimixers *(in center)* automatically mix two or more high or low pressure gases of variable heating value in any volume, holding the final product undeviatingly to a stipulated figure.

CUTLER-HAMMER
B.t.u. CONTROL
C-H

C-H Jet type mixers *(at right)* automatically mix gases of variable heating value to a final low pressure stabilized value. When mixing directly into gas mains as well as into holders, they automatically adjust production to widely varying demands.



Cabled copper instrument tubing installed at Appalachian Electric Power Company's Kanawha River Station. You see it at the point where the cable divides for run-outs to instruments. Note smooth, short-radius bends.

108,000 feet of cabled copper instrument-control tubing helps keep Kanawha River Power Station humming

Hundreds of air-actuated instruments are an important part of the instrumentation control network at the 430,000-kw Kanawha River Station of the Appalachian Electric Power Company – part of the American Gas and Electric System. The size of the plant called for instrument tubing runs of up to 1,000 feet – with tubing cabled in bundles. For economical stranding, the tubing was needed in unusual lengths – without joints. To conserve space, small diameter tubing was needed. And ability to take short-radius bends without pinching was necessary.

The 108,000 feet of Anaconda Seamless Copper Tubing was supplied in 1,000-feet lengths. Outside diameter was only ¼-inch, wall thickness only .030". Shown above are typical tube bundles as they near terminal connections.

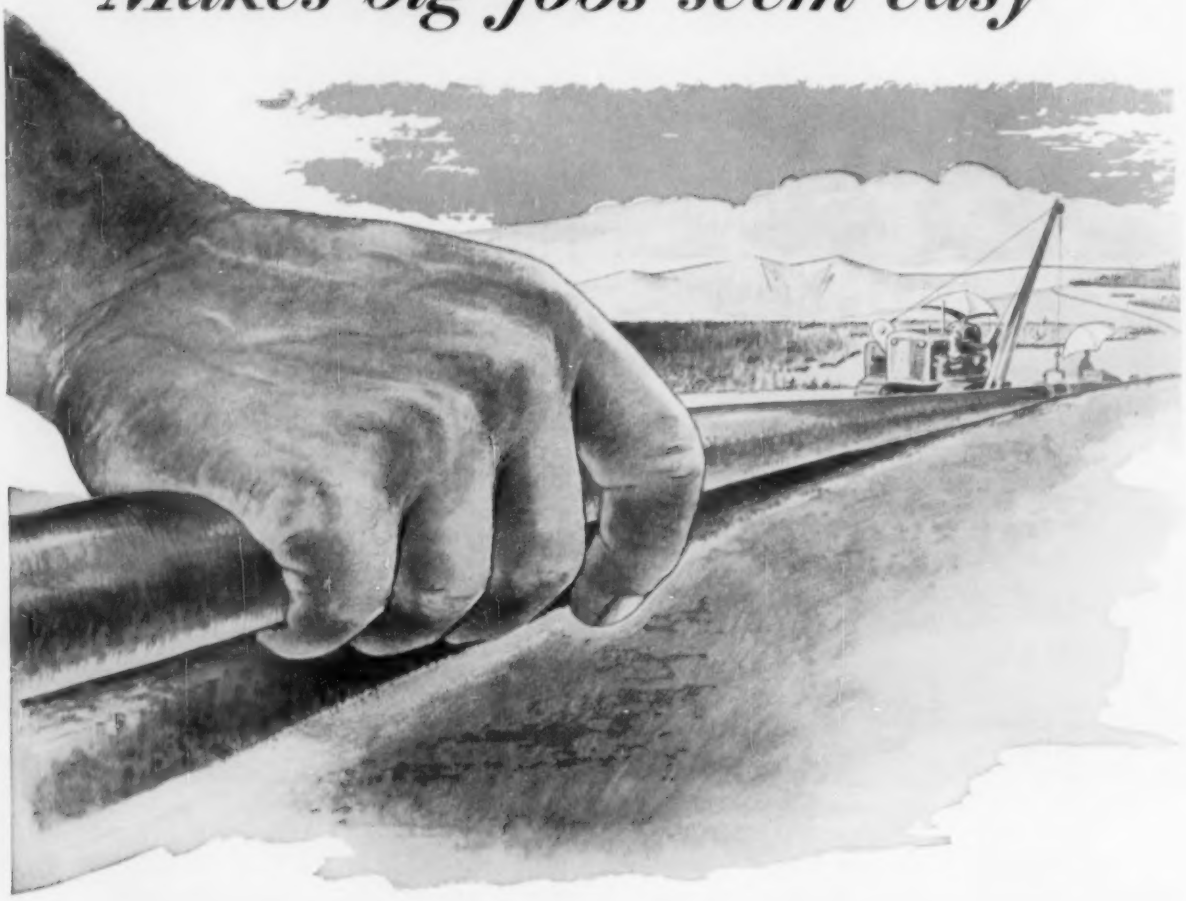
Anaconda small-bore, thin-wall tubing is available in lengths up to 2,400 feet. It comes in long coils on reels, or cut to your requirements. Capillary tubes, restrictor tubes, Bourdon tubes, special shapes, and fabricated tubes and parts for refrigeration and air-conditioning are available in many different alloys. These include phosphorized and OFHC copper, the full range of brasses, 3,003 aluminum, nickel silvers, and certain special alloys. For more information about Anaconda small-bore tubes and special shapes ask any district sales office, or write direct to *The American Brass Company, Waterbury 20, Connecticut.* In Canada: *Anaconda American Brass Ltd., New Toronto, Ontario.* 6578

Some of the many sizes and shapes of Anaconda Small-diameter Tubes.

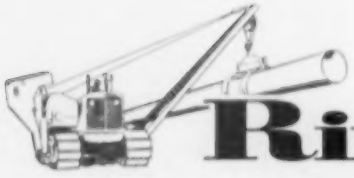
ANACONDA®
SMALL DIAMETER TUBES

River

Makes big jobs seem easy



It takes planning, equipment and trained crews to complete pipeline contracts ahead of schedule. It takes the experience gained in the thousands of miles of pipeline that River has finished to overcome the obstacles of terrain and weather and come out ahead. Put River Construction to work on your next contract and watch the job completed... to your satisfaction — *on time!* River is just the right size... big enough to handle any job... small enough to give your contract the personal attention it deserves.



River CONSTRUCTION CORPORATION

ROBERT THOMAS
J. C. BRISCOE
J. C. MINYARD

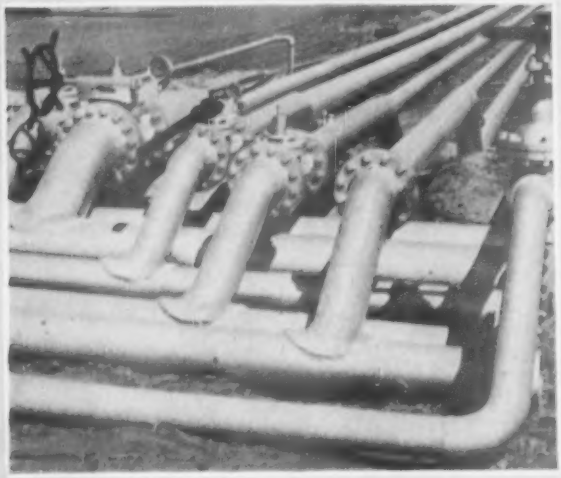
GENERAL OFFICES: 6100 CAMP BOWIE BLVD., P. O. BOX 9127, FORT WORTH, TEXAS

HELPFUL SERVICES *for* PIPELINERS

Most pipeline men know that very little crude oil is shipped through lines unless it passes specifications for BS and W. Experienced pipeliners also know that the majority of producers everywhere use Tret-O-lite demulsifiers to insure that their crudes do meet pipeline specifications.

TRET-O-LITE DEMULSIFIERS
for eliminating tank bottoms

KONTOL CORROSION INHIBITORS
for preventing corrosion and cleaning lines

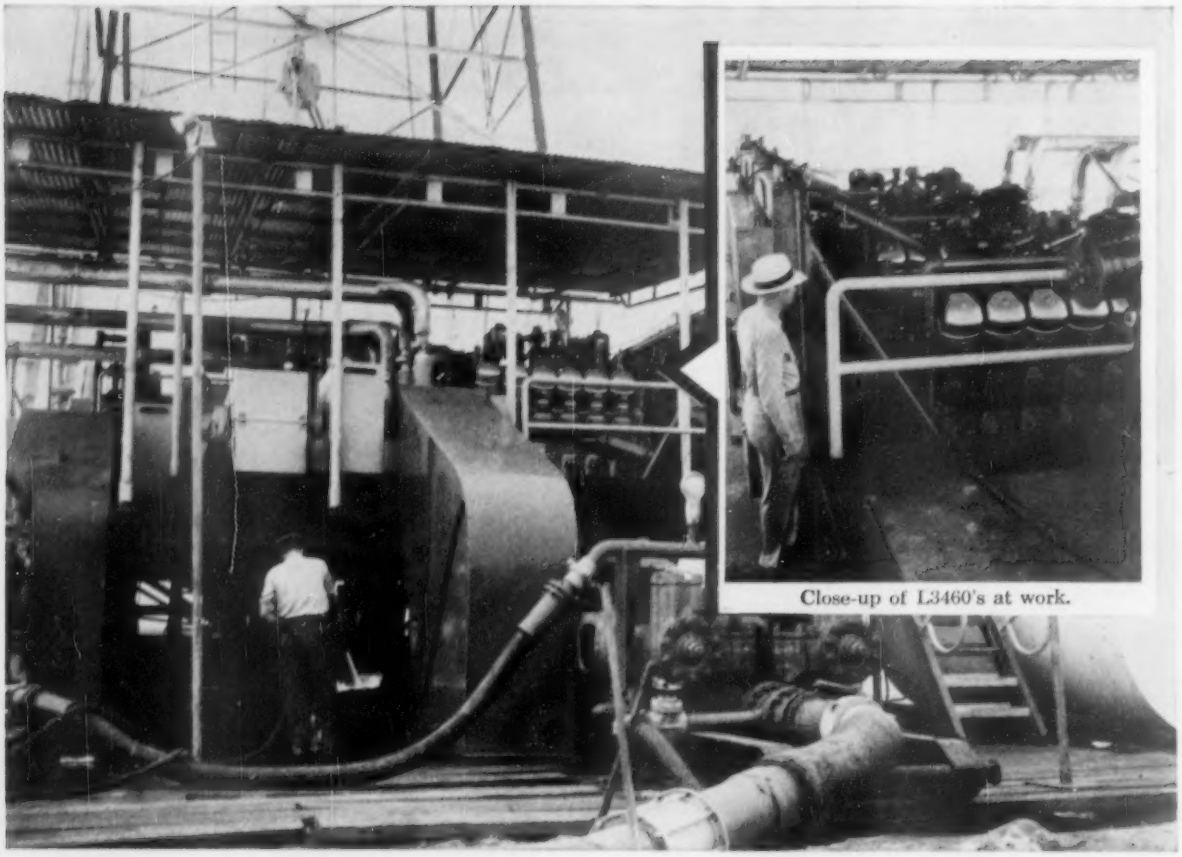


The Tretolite Company also offers products and services designed to alleviate many of the problems encountered in transporting oil through pipelines. If you don't have complete information on how these products can help you, get in touch with your nearest Tretolite service engineer or write to

TRETOLITE COMPANY
A DIVISION OF PETROLITE CORPORATION
369 Marshall Avenue, St. Louis 19, Missouri
5515 Telegraph Road, Los Angeles 22, California

KPL 55-11

KONTOL SPECIAL
CORROSION INHIBITORS *for preventing rust and corrosion in product lines*



Close-up of L3460's at work.

Here's the Way to Power a Rig...for Deep Holes!

...use LeRoi L3460 or L4000 V-12 drilling engines to get the outstanding acceleration and lugging power you need for faster round trips

If you have an engine that can stand the gaff on deep holes — you have an engine that can help you bottom any hole at lower cost.

The L3460 and L4000 can do just that. It's been proven time and time again.

Let's look at the L3460. It develops 600 hp maximum. On one rig two of these engines hoisted 5-inch pipe from 8300 feet in just two hours — and this was a wet trip. That's proof of both acceleration and lugging power.

The L4000 is the L3460's twin except for displacement. It produces 655 maximum hp. Both engines are only 164 inches long so that they have the compactness that helps you keep to overall width and weight limitations. And they're built to stand oil-field handling.

Not only do you get more horsepower per dollar from these V-12's, but you also get these important features: Short-stroke design that gives you greater horsepower and speed, without compromising engine life. Wide speed range up to 1350 rpm. Operation on oilfield fuels —natural gas or butane. Conservative rating. Lightweight pistons, hydraulic tappets, short-radius rotating parts, and sensitive controls to provide hair-trigger response to load demands.

Yes, you can drill them deep and drill them fast with L3460's or L4000's. Let your supply house or Le Roi distributor show you why. If you want descriptive literature, just write us for it.

P-136

LE ROI *Division of Westinghouse Air Brake Co.*

Milwaukee 14, Wisconsin

PORTABLE AIR COMPRESSORS

TRACTAIR

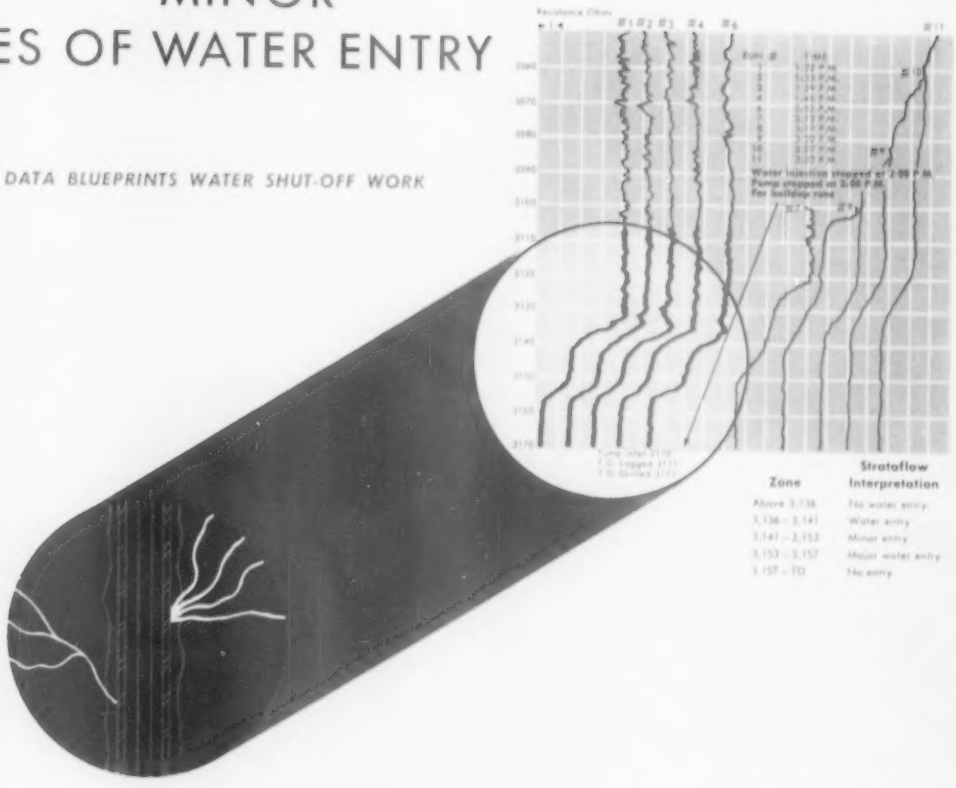
STATIONARY AIR COMPRESSORS

AIR TOOLS

ENGINES

LOGS MAJOR *AND* MINOR ZONES OF WATER ENTRY

STRATAFLOW DATA BLUEPRINTS WATER SHUT-OFF WORK


Water injection stopped at 2:00 P.M.
Pump stopped at 3:00 P.M.
for holdup runs
Zone
Stratoflow Interpretation
Above 3,136 — No water entry
3,136 – 3,141 — Water entry
3,141 – 3,153 — Minor entry
3,153 – 3,157 — Major water entry
3,157 – TD — No entry

An accurate, foot-by-foot record of water entry zones, secured while the well is in *normal* production, gives a dependable blueprint for remedial work designed to shut off water. Halliburton's Strataflow Log, the exclusive system for logging all water entry points in any producing well, effectively guides the workover operations that can help restore profitable production.

Both major and minor water zones are clearly indicated on the easy-to-interpret Strataflow Log. A special 1" electrode accurately measures the difference in resistivity between a conditioning fluid, usually fresh water placed in the bore, and the saltier waters flowing from formations. The measurements are made with the well in normal production – with all water and oil zones continuously producing normal fluids!

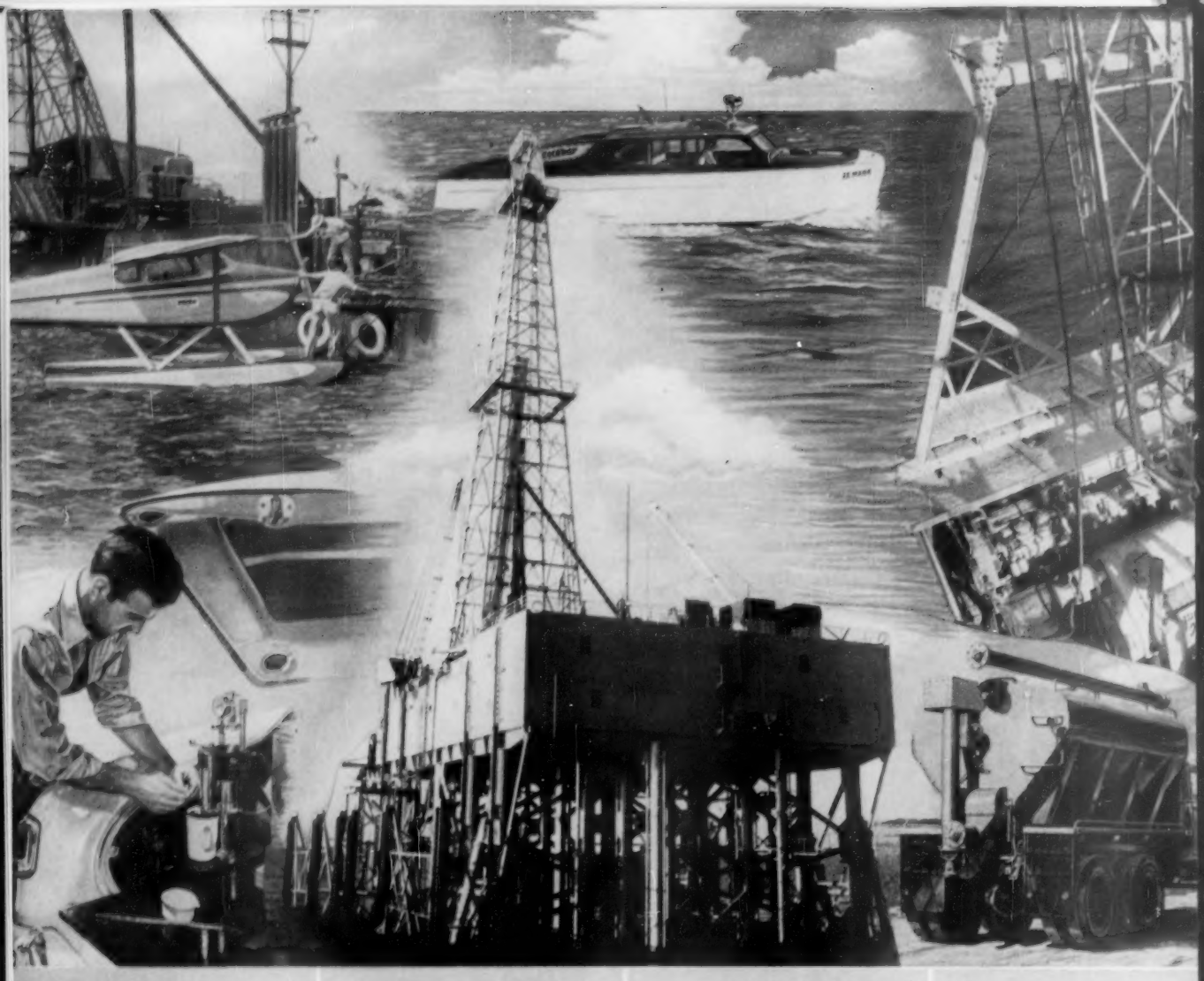
Strataflow data gives you the information you need for planning successful W.S.O. work with less downtime, expense and trouble. When water entry is hurting your production, call for a Strataflow survey as the logical first step in restoring full, profitable production – without water. Call your local or district office of Halliburton Oil Well Cementing Company.

HALLIBURTON

ELECTRICAL WELL SERVICES

Strataflow – Reg. U.S. Pat. Off.

211 SERVICE CENTERS – JUST MINUTES AWAY FROM ANY RIG



IDECO

IDECO, Dallas, Tex.—Hydrair and Power Rigs; Full-View Masts; Substructures; Single, Dual and Drive-In Rambler Rigs; Blocks, Swivels, Rotaries; Mud-Pumps; Petroleum Equipment and Supplies.

CLARK

CLARK BROS. CO. DIVISION, Olean, New York—Engines and reciprocating, centrifugal, and axialflow compressors — gas, steam, electric and diesel driven.

Security

SECURITY ENGINEERING DIVISION, Dallas, Tex., Whittier, Calif.—Rock bits, coring bits, reamer rock bits, reamers, casing scrapers, Securaloy.

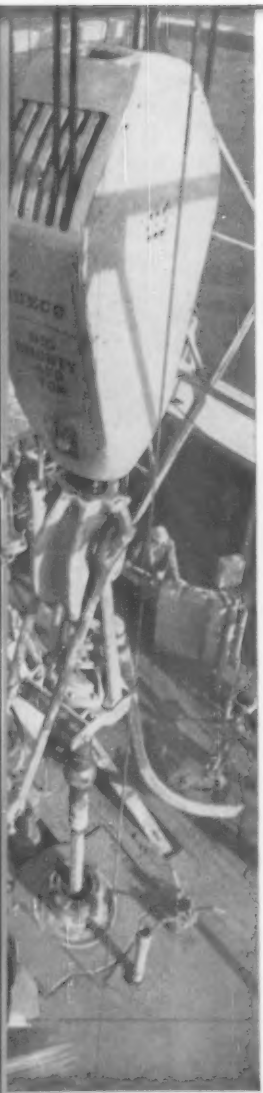
PACIFIC

PACIFIC PUMPS, INC., Huntington Park, Calif. — Centrifugal pumps for refineries, power stations, pipelines, and chemical plants; plunger pumps for oilwells.

Magcobar

the mud with the extra quality

Magcobar quality drilling mud products . . . plus prompt at-the-rig engineering service . . . are an unbeatable team in today's highly specialized drilling operations. Magcobar's modern mines and plants, the industry's largest producing facilities, provide the most complete line of drilling mud products in the world today. To augment these facilities, Magcobar research laboratories are constantly striving to make drilling operations more efficient and economical. Around-the-clock service at your rig is provided by Magcobar engineers who travel in laboratory-equipped cars, planes and boats in all active North American oil fields. This great combination — quality and service — is available to you through more than 400 Magcobar dealers. Call them for prompt at-the-rig service and the finest mud available.



How the DRESSER *plus* + works...

Offshore drilling takes ocean-going experts. Magcobar drilling muds and Ideco drilling equipment are a seaworthy team bringing the Dresser Plus + to Kerr-McGee's rig No. 44 off the Gulf Coast. Carefully developed suspending and sealing properties and high quality standards make Magcobar drilling muds *extra* dependable for economic, efficient drilling... anywhere. To supply offshore locations with specially packaged mud additives, Magcobar and its dealers operate an extensive barge fleet along the Gulf Coast. Ideco equipment on the big Kermac rig includes Airflo 1350-S rig, Hydrair H-35-S rig, 400-ton Big Shorty block, 300-ton Streamlined swivel, Streamlined oil-bath rotary, two Clark-Ideco T-880 slush pumps, and driller's console.

The Dresser Plus + is the *extra* plus value you get when you are served by any one of the Dresser Industries. Operating independently to assure maximum attention to your specific needs, these Dresser companies work together to provide a versatile group of research, engineering and manufacturing services. On land or sea... Dresser oil, gas and chemical equipment and services are the standard of comparison the world over!

ROOTS-CONNERSVILLE BLOWER DIVISION, Connersville, Ind.—Rotary positive blowers, gas pumps, centrifugal blowers, exhausters, and positive displacement meters.

LANE-WELLS CO., Los Angeles, Calif., Houston, Tex., Oklahoma City, Okla.—Electric and Radioactivity Well Logging, Koneshot perforating and bullet perforating, packers and bridging plugs.

DRESSER-IDECO DIVISION, Columbus, Ohio—Radio and television broadcasting towers, steel buildings, aircraft hangars, mechanical parking garages, electric power substations.

DRESSER MANUFACTURING DIVISION, Bradford, Pa.—Pipe line couplings, pipe repair sleeves and clamps, weldments, forgings, welding fittings, flanges, rings.

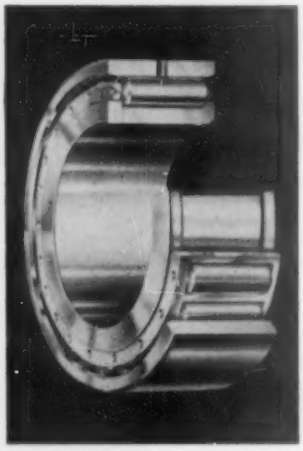
DRESSER INDUSTRIES, INC.
OIL, GAS AND CHEMICAL EQUIPMENT

REPUBLIC NATIONAL BANK BUILDING • POST OFFICE BOX 718 • DALLAS 21, TEXAS

IN THE OIL INDUSTRY, TORRINGTON *Bearings are used in many applications including slush pumps, rotary tables, draw works, blocks, swivels and pumping units.*

TORRINGTON Radial Roller Bearings

are designed with one-piece bronze retainer that keeps rollers correctly aligned and effectively lubricated



Here are other reasons why TORRINGTON RADIAL ROLLER BEARINGS can meet your load and speed requirements. Only the finest quality steels, heat treated according to the most modern methods, are used in manufacture.

Precision tolerances and finishes on both rollers and races guarantee low eccentricity and uniform load distribution.

One-piece, cast-bronze cages help minimize wear, facilitate lubrication, and lengthen bearing life.

Machined pads in each cage-pocket guide the rollers accurately at the pitchline.

Specify TORRINGTON RADIAL ROLLER BEARINGS for your equipment. They are interchangeable in all types and sizes and custom engineered to meet the toughest, heavy duty assignments.

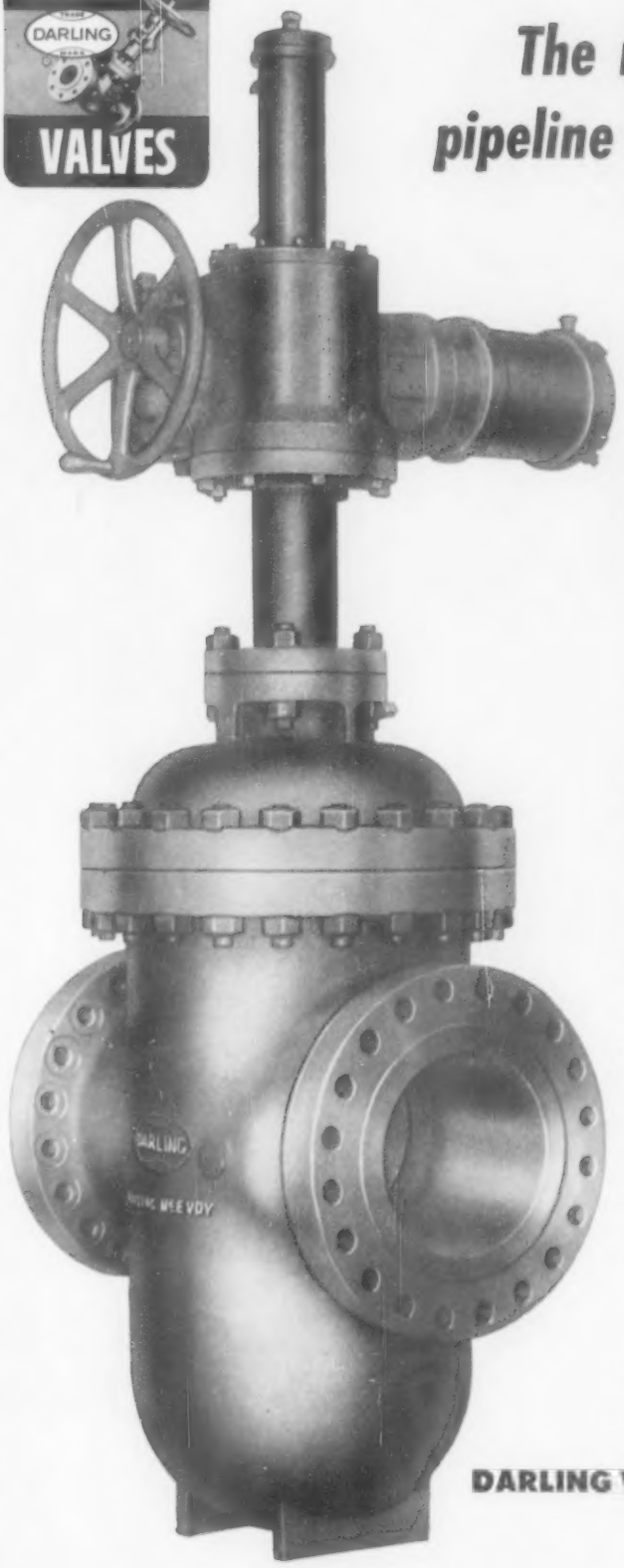
THE TORRINGTON COMPANY
South Bend 21, Ind. • Torrington, Conn.

District Offices and Distributors in Principal Cities of United States and Canada

TORRINGTON RADIAL ROLLER BEARINGS

Spherical Roller • Tapered Roller • Cylindrical Roller • Needle • Ball • Needle Rollers

DARLING VALVES



The most important pipeline valve development in years

TRADE DARLING MARK McEvoy

New self-sealing two-way conduit valve for pipeline service automatically injects sealant by means of existing line pressure

Here's a new type of conduit gate valve, available in 8-inch and larger sizes, that gives positive downstream closure without dependence on metal-to-metal contact. Each time the valve closes, the required amount of sealant is applied automatically.

How it works

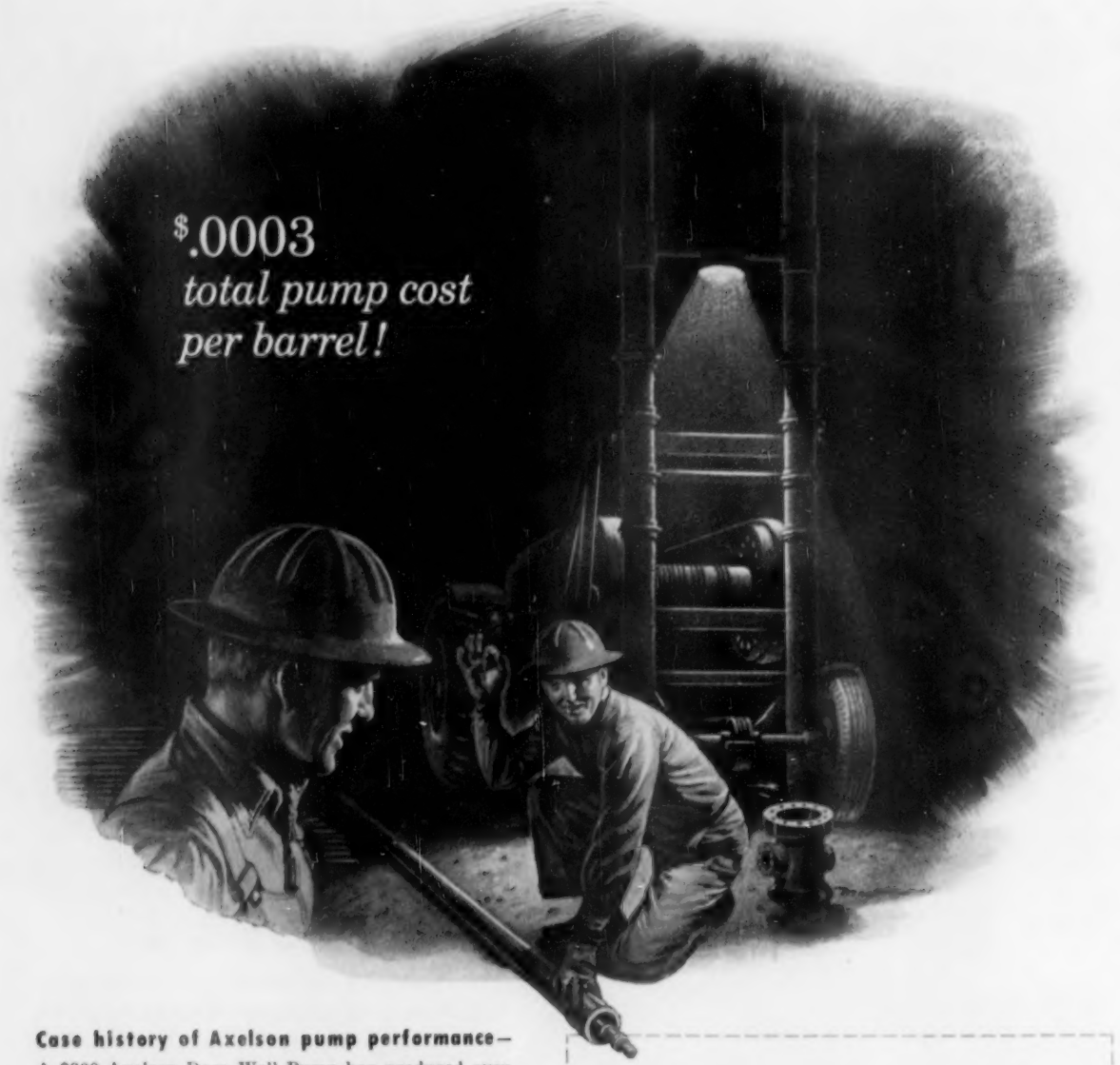
Employing the time-tested McEvoy principle, two cylinders, filled with special sealant, are located within the valve. Both are operated by line pressure. Depending on the direction of flow, line pressure actuates one or the other of these cylinders to force sealant into a channel in the downstream face of the seat. Since these cylinders hold enough sealant for 50 or more closures, the valves need only periodic servicing for recharging with sealant.

Write for details

Ask for bulletin #5402 which contains complete information on the design and operation of this valve.

DARLING VALVE & MANUFACTURING CO.
Williamsport 1, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario



Case history of Axelson pump performance—

A $300 Axelson Deep Well Pump has produced over $2,000,000 worth of oil without a single pulling job! Here is a report from the oil company: "An Axelson 2½" x 2¼" x 11' tubing liner pump produced approximately 1,000,000 barrels of oil over a ten year period from a Tensleep well in West Central Wyoming. It was operating at an over-all efficiency of 90 percent at the time it was pulled to check for slippage, which was believed to be causing tight emulsion."

Here's why: Axelson's 63 years experience in the manufacture of Deep Oil Well Pumping equipment has clearly indicated the need for tailoring pump parts to resist specific well conditions. Wise operators call in Axelson field experts for well analysis and the specification of the correct equipment for trouble-free operation.

Send for Pump Information

AXELSON
Deep Well Pumps

AXELSON MANUFACTURING COMPANY • DIVISION OF U. S. INDUSTRIES, INC. • LOS ANGELES 58, NEW YORK 7, TULSA 1, ST. LOUIS 16

GENERAL OFFICES: P.O. BOX 58335 VERNON STATION, LOS ANGELES 58

DISTRIBUTORS—Jones & Laughlin Steel Corp., Supply Division; Great Northern Tool & Supply Company; Jones & Laughlin Steel Sales Co., Ltd., Supply Division, Edmonton, Alberta, Canada; Dominion Oilfields Supply Co., Ltd., Calgary, Alberta, Canada; Adrian Bolland & Cia., S.R.L., Buenos Aires, Argentina, S.A.; Gross Equipment S.A., Lima, Peru, S.A.; Industrial Agencies, Ltd., San Fernando, Trinidad, B.W.I.; MAQUIP (Comercial de Marquinas e Equipamentos) S.A., Rio De Janeiro, Brazil, S.A., Servicios Industriales, C.A., Barcelona, Venezuela, S.A.; Servicios Industriales, C.A., Maracaibo, Venezuela, S.A.; Wells Fargo & Co. Express, S.A., Mexico, D.F.

THE SCHLUMBERGER LATEROLOG LOOKS AT THE FORMATIONS, ONE BY ONE. The focused current is beamed laterally into the formation, minimizing the effect of the bore hole and adjacent formations. As a result, the Laterolog gives you accurate formation detail when the mud is salty or when the formation resistance is high. Therefore, this important Schlumberger development gives you correct information under conditions that may have previously caused you to pass up production possibilities. Be sure on every survey.

THE EYES OF THE OIL INDUSTRY

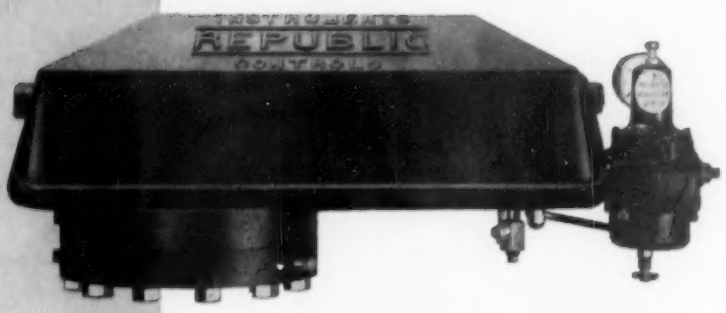
SCHLUMBERGER

Well Surveying Corporation

COMBINES MACHINE RUGGEDNESS WITH INSTRUMENT PRECISION for dependable low maintenance metering

REPUBLIC

pneumatic transmitter for measuring FLOW, PRESSURE, LEVEL or DENSITY...



Machine dependability with instrument accuracy and sensitivity! Think what this combination of features can mean in your plant—less maintenance, longer life for lowest "long run" cost, *continuous* accurate operation.

You get all of these benefits and more with the Republic Pneumatic Transmitter. Force-balance operation permits the use of strong rugged parts with no sacrifice in accuracy or sensitivity. Gives exceptional overrange protection.

Housed in a durable metal case, the transmitter may be adjusted for mounting at any angle, indoors or out. Its accuracy is not affected by changes in ambient temperature vibration, normal changes in supply air pressure or inaccurate leveling. Uses no mercury or purge pots. Can be used with very viscous fluids.

The Republic transmitter isolates fluids to a measuring chamber which may be supplied in a variety of corrosion resistant materials. It sends an air pressure proportional to fluid flow, pressure, level or density to reading instruments or for actuation of an automatic controller.

Republic Pneumatic Transmitters are proving their superiority in hundreds of chemical and oil field applications. Investigate their advantages for you — write for your free copy of 36 page Data Book No. 1004.

SPECIFICATIONS:

ACCURACY — ½% of maximum range guaranteed for standard models.

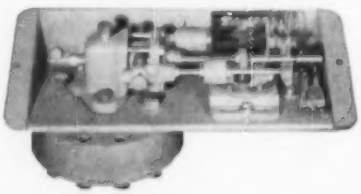
DIFFERENTIAL RANGES — Any desired span between 0-0.6" H_2O and 0-750 psi at operating pressures of 15 psig to 2000 psig.

PRESSURE RANGES — Any desired span between 0-1" H_2O and 0-2000 psig.

LEVEL RANGES — to meet almost any application.

DENSITY RANGES — 0.15 sp. gravity spread for 3 to 15 psig output pressure from any base density.

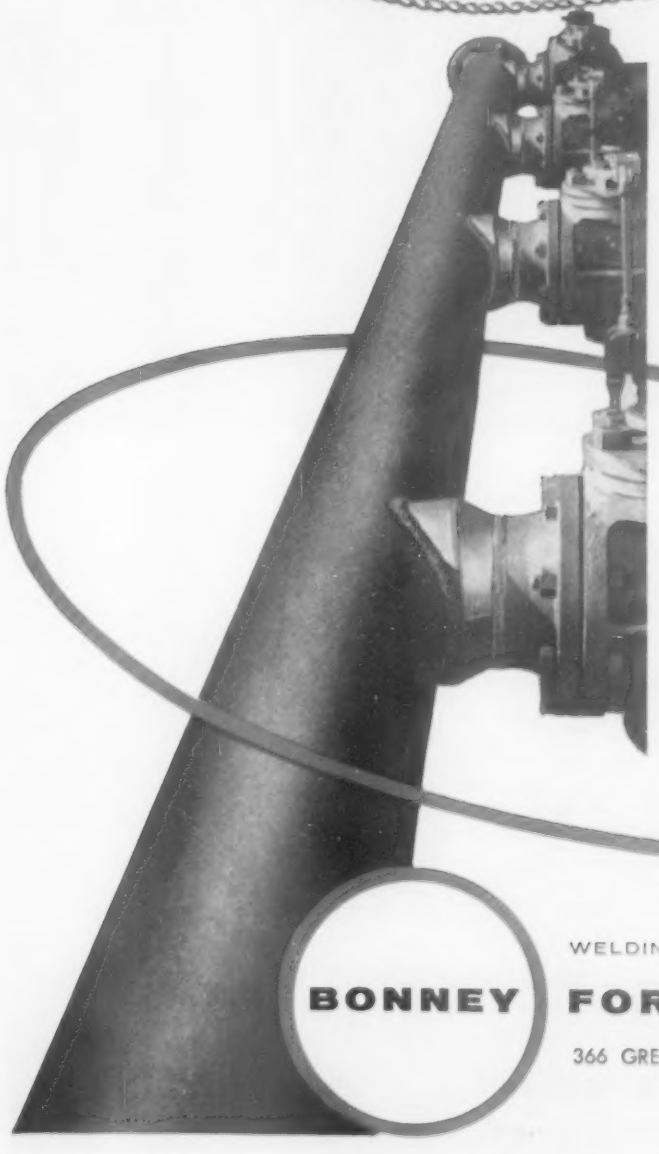
Extremely wide range change is possible without change of parts. Ranges may be easily changed, suppressed, compounded or reversed.



● ***EASILY SERVICED*** Cover can be completely removed for access to all range adjustments and replaceable parts. No special tools required.

REPUBLIC FLOW METERS CO.

2240 Diversey Parkway, Chicago 47, Illinois



customer reduces estimate of job cost $24,000 by switch to WELDOLETS

An oil piping contract recently was reduced by $24,000 by changing specifications to WELDOLET welding fittings.

Comparable savings are possible on almost every piping contract. It will pay you to examine this positive means of reducing your piping costs. Write us for details.

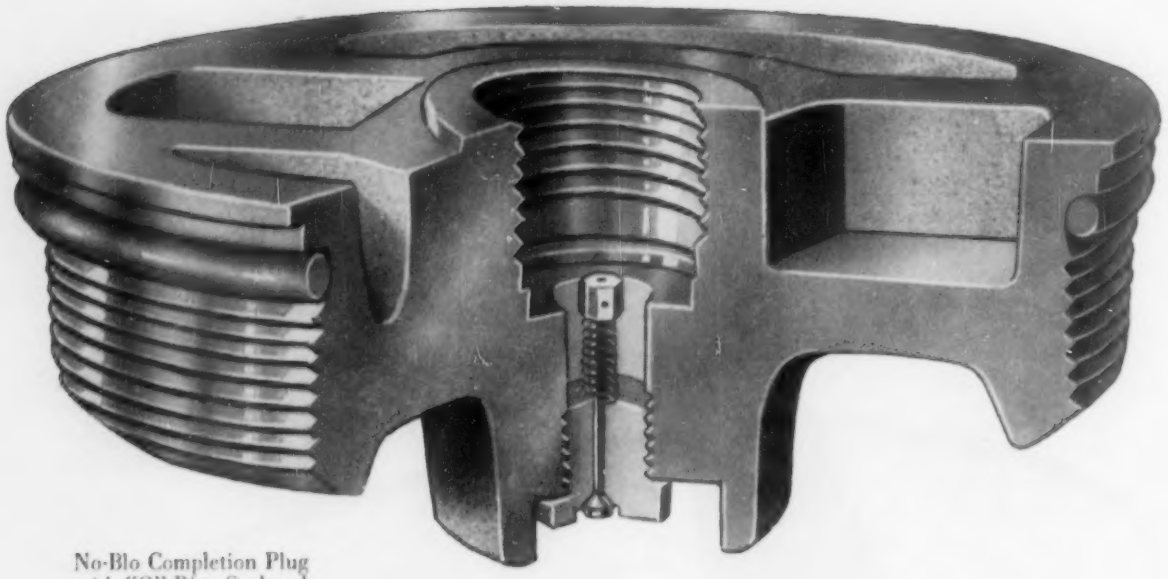
WELDING FITTINGS DIVISION

BONNEY FORGE & TOOL WORKS

366 GREEN ST., ALLENTOWN, PENNA.

MUELLER

THE KEY TO SAFE OPERATIONS



No-Blo Completion Plug with "O" Ring Seal and Pressure Equalizing Valve

NO-BLO

Repair or relocation of lines, permanent or temporary laterals, dead end extensions, and a host of other operations are readily done under pressure, in complete safety, with Mueller No-Blo Fittings.

The No-Blo Completion Plug (shown above) is an exclusive and vital part of the No-Blo Line Stopper Fittings, Flanged Tees, Save-A-Valve Drilling Nipples and Extension Stopper Fittings. Inserted into the top of the fitting under pressure, the plug provides a positive seal to allow the safe removal of the equipment when the operation is complete. At no time is flow interrupted or fluid permitted to escape.

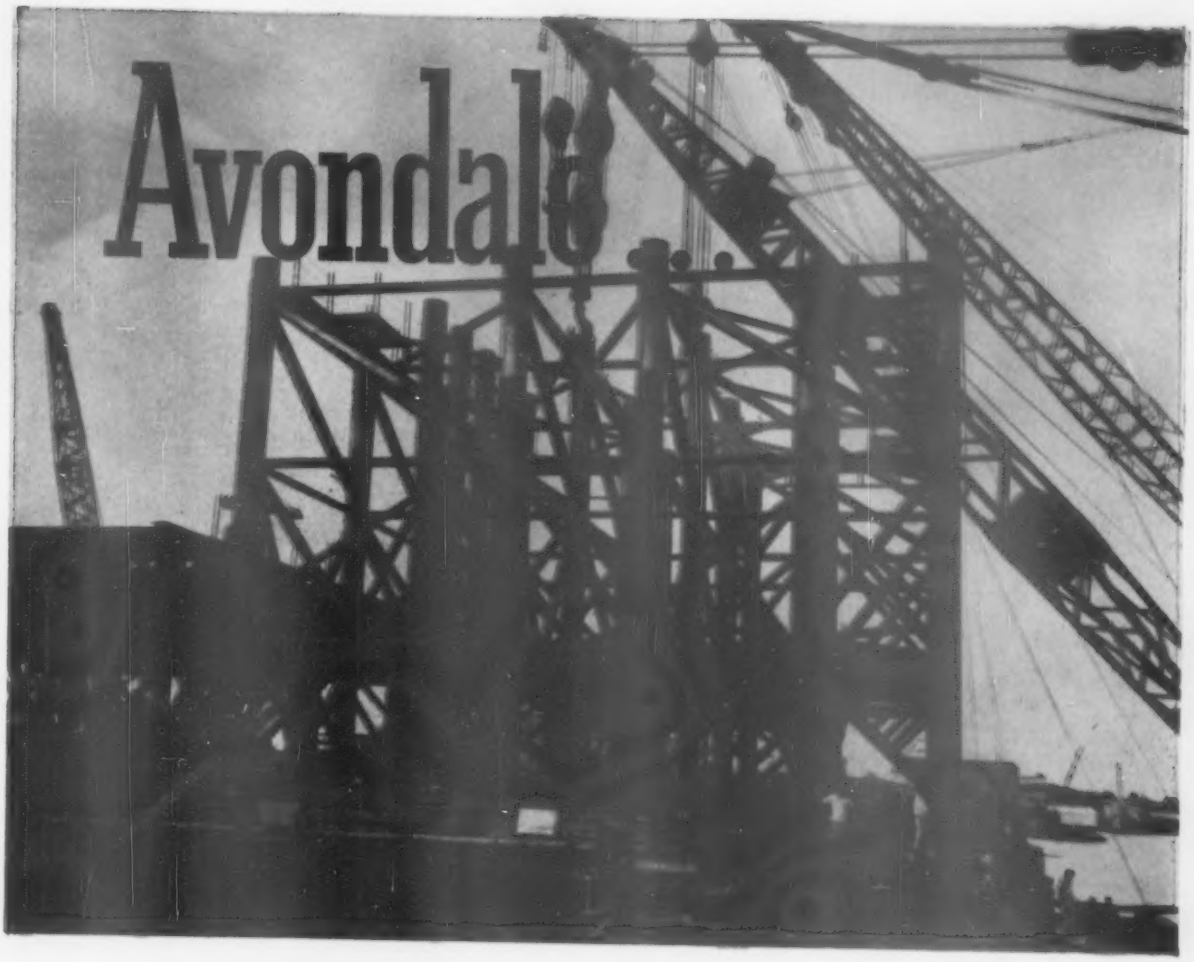
The new pressure equalizing valve balances the pressure above and below the plug for easier insertion and extraction. At any future time, the plug may be removed and the fitting reused for its original purpose.

Write direct for full details and specifications on No-Blo Fittings and related Machines.

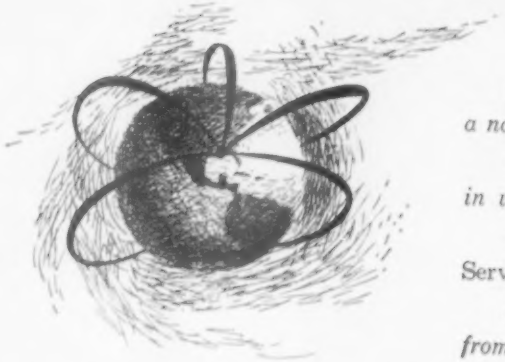
MUELLER CO. DECATUR, ILL.

Dependable since 1857

FACTORIES & OFFICES AT DECATUR · CHATTANOOGA · LOS ANGELES · SARNIA, ONTARIO



service • integrity • efficiency



Avondale barges, towboats, tugboats, drilling barges, personnel launches and offshore drilling platforms have made a name for themselves within the Oil Industry as being tops in Quality and Performance. Avondale's Service, *the manner in which Avondale carries out a job to the letter, has made customers return to Avondale time and time again. Couple* Service *with the two words,* Integrity *and* Efficiency, *and you have the ultimate in what the Oil Industry needs and wants from a company rendering service to them . . . .*

SHIP BUILDING • SHIP REPAIRING • FOUNDERS • PROPELLERS • STRUCTURAL STEEL

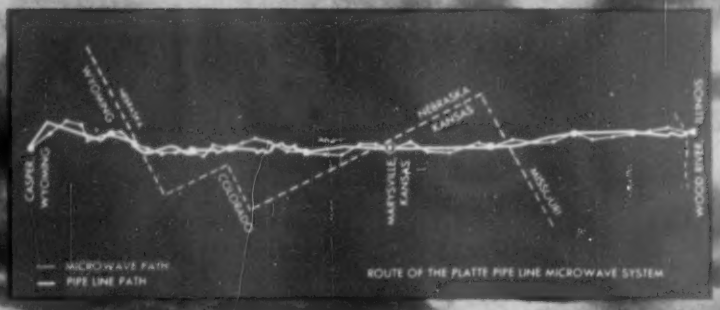
AVONDALE MARINE WAYS, INC. CABLE ADDRESS "AVONWAYS"

P. O. BOX 1030 • PHONE UNiversity 4561 • NEW ORLEANS 8, U. S. A.

PHILCO MICROWAVE.

HOW PHILCO MICROWAVE IS HELPING PLATTE:

- **Operating efficiency increased.**
- **Operating costs reduced.**
- **Provides these communications facilities:**
  4 separate telephone circuits for business, dispatch, confidential and stockholder use.
- **Provides these control functions from Kansas City Control Center:**
  Reading of tank levels, pressure, flow of oil.
  Opening and closing of line valves.
  Start and stop main line pumps.
  Station shutdown.



Platte microwave repeater station at Midway, Wyoming

PHILCO Symbol of QUALITY in Radio Communication

PHILCO CORPORATION

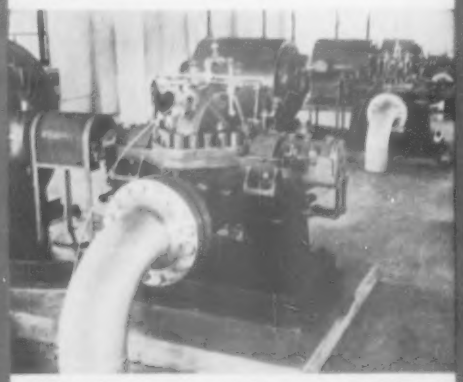
..boosts Platte Pipe Line efficiency!

The Philco microwave system of the Platte Pipe Line Company—the largest and most comprehensive installation of its kind—demonstrates the economic advantages of microwave better than any other pipe line microwave system in the nation. Here is what A. R. Heidebrecht, Chief Engineer of Platte, has to say about the system: "Our decision to use microwave was greatly influenced by the number of pipe line control functions which could be accomplished remotely and automatically. Operation to date has proved very successful; in fact, during the short time this system has been in use, the efficiency of our pipe line operation has been substantially increased."

Perhaps microwave can lower operating costs and boost the efficiency of your plant. Philco maintains a staff of experienced field and system engineers who can help plan and install your microwave system. Get information on the many leading Philco microwave installations in use today. Write to Philco, Dept. OG.

Platte Pipe Line control center at Kansas City.

Microwave operates valves along the pipe line.

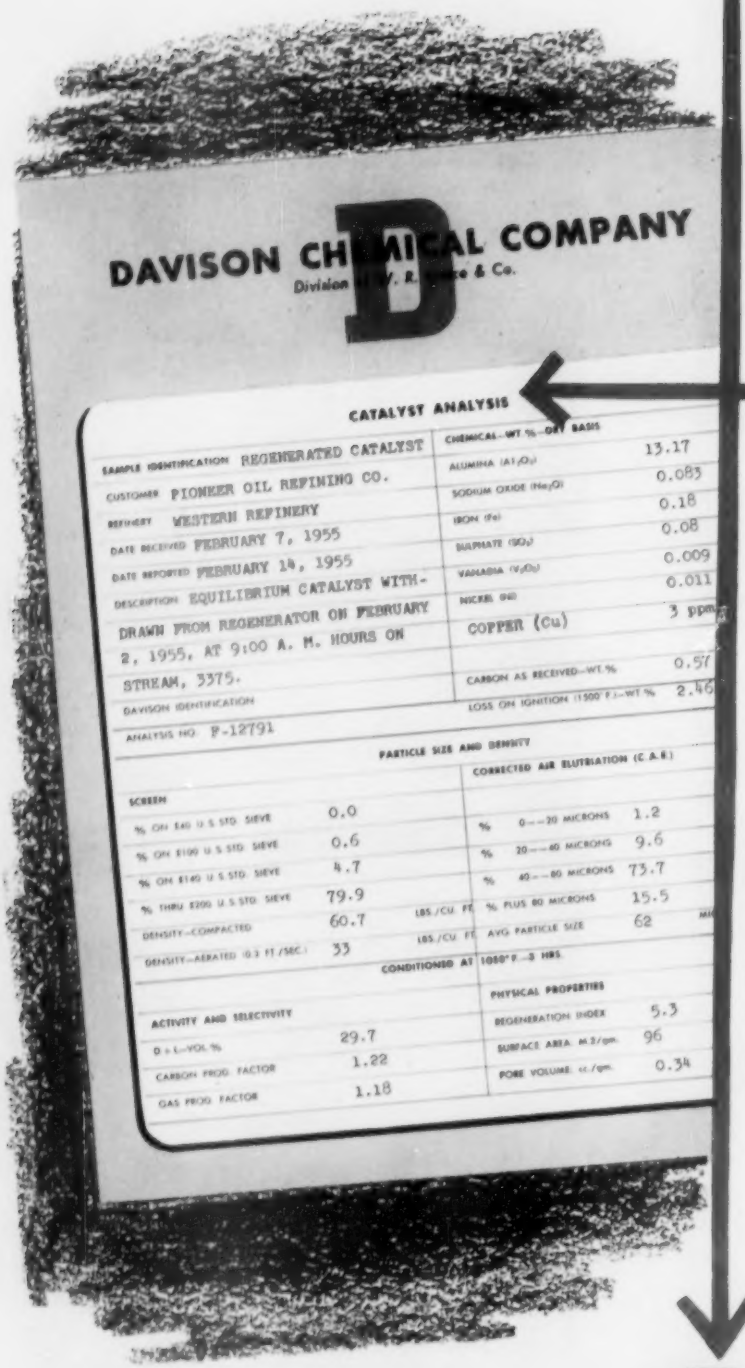


Pipe line pump station operated by microwave.

PHILCO—WORLD'S LEADING MANUFACTURER OF MICROWAVE

GOVERNMENT AND INDUSTRIAL DIVISION • PHILADELPHIA 44, PENNSYLVANIA

In Canada: Philco Corporation of Canada Limited, Don Mills, Ontario


DAVISON CHEMICAL COMPANY
Division of W. R. Grace & Co.
CATALYST ANALYSIS
SAMPLE IDENTIFICATION REGENERATED CATALYST
CUSTOMER PIONEER OIL REFINING CO.
REFINERY WESTERN REFINERY
DATE RECEIVED FEBRUARY 7, 1955
DATE REPORTED FEBRUARY 14, 1955
DESCRIPTION EQUILIBRIUM CATALYST WITH-
DRAWN FROM REGENERATOR ON FEBRUARY
2, 1955, AT 9:00 A. M. HOURS ON
STREAM, 3375.
DAVISON IDENTIFICATION
ANALYSIS NO. F-12791
CHEMICAL—WT. %—DRY BASIS
ALUMINA (Al2O3) 13.17
SODIUM OXIDE (Na2O) 0.083
IRON (Fe) 0.18
SULPHATE (SO4) 0.08
VANADIA (V2O5) 0.009
NICKEL (Ni) 0.011
COPPER (Cu) 3 ppm
CARBON AS RECEIVED—WT. % 0.57
LOSS ON IGNITION (1500° F.)—WT. % 2.46
PARTICLE SIZE AND DENSITY
SCREEN
% ON #40 U. S. STD. SIEVE 0.0
% ON #100 U. S. STD. SIEVE 0.6
% ON #140 U. S. STD. SIEVE 4.7
% THRU #200 U. S. STD. SIEVE 79.9
DENSITY—COMPACTED 60.7 LBS./CU. FT.
DENSITY—AERATED (0.3 FT./SEC.) 33 LBS./CU. FT.
CORRECTED AIR ELUTRIATION (C.A.E.)
% 0—20 MICRONS 1.2
% 20—40 MICRONS 9.6
% 40—80 MICRONS 73.7
% PLUS 80 MICRONS 15.5
AVG. PARTICLE SIZE 62 MI
CONDITIONED AT 1050° F.—3 HRS.
ACTIVITY AND SELECTIVITY
D + L—VOL. % 29.7
CARBON PROD. FACTOR 1.22
GAS PROD. FACTOR 1.18
PHYSICAL PROPERTIES
REGENERATION INDEX 5.3
SURFACE AREA M.2/gm. 96
PORE VOLUME cc./gm. 0.34

Your guide to better Catalyst Performance

With catalysts it is the actual performance that is important.

A guide to this performance is to keep a constant check on the characteristics of the catalysts in your units. Realizing the importance of this, Davison maintains modern laboratories for analyzing equilibrium catalyst samples. Refinery experienced engineers regularly evaluate and report on the significance of these data. This is a regular Davison service given to Davison catalyst customers at no cost to the refiner.

For additional information on this service and Davison's M-S® catalyst, the most widely used synthetic cracking catalyst, see your Davison representative.

Progress Through Chemistry

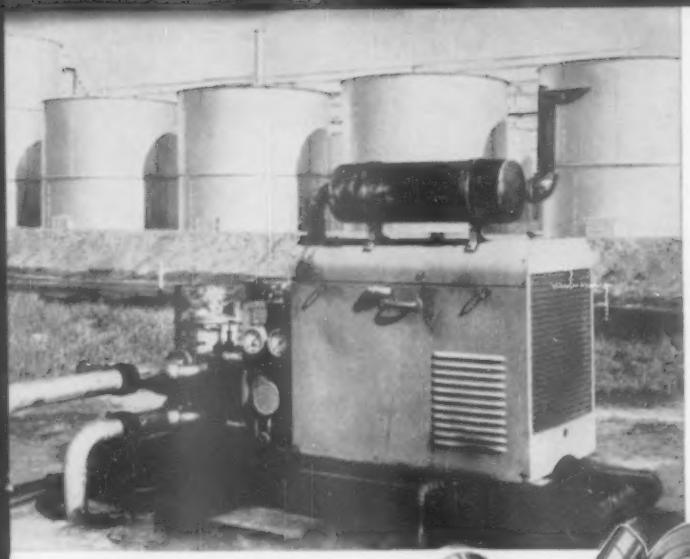
DAVISON CHEMICAL COMPANY

Division of W. R. Grace & Co.

Baltimore 3, Maryland

Sales offices: Chicago, Ill.; Houston, Texas; New York, N. Y.; Baltimore, Md.

Producers of: Catalysts, Inorganic Acids, Superphosphates, Triple Superphosphates, Phosphate Rock, Silica Gels and Silicofluorides. Sole Producers of DAVCO® Granulated Fertilizers.

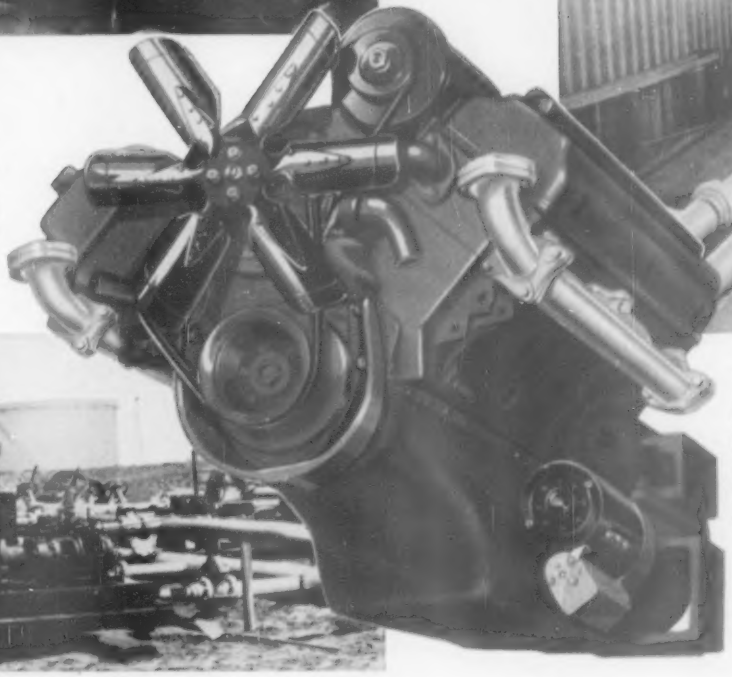


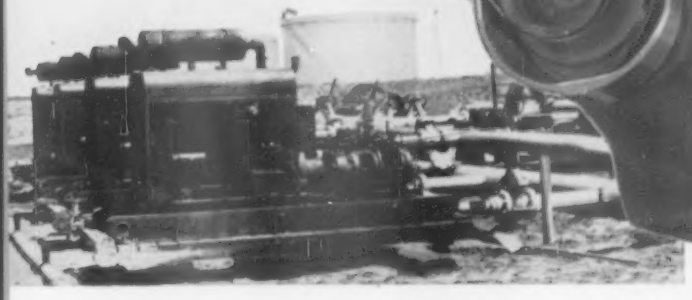
Production

Chrysler Engine driving an oil gathering pump in Brooks County, Texas.

Pipe Line Gathering

Winkler County, Texas gathering pumps are driven by four Chrysler Engines.





Processing

Chrysler-powered fire fighting unit pump stands ready at main line pumping station near Eldorado, Texas.

CHRYSLER IND. 56 331 CUBIC INCHES DISPLACEMENT ENGINE

Chrysler Powers the Pumps for Petroleum

Every day more and more oil operators see in Chrysler Industrial Engines the kind of power they need for petroleum. Nowhere is this more true than in power for pumps. Chrysler Industrial Engines and Power Units drive pumps used in producing, pipe line gathering and processing. The reasons are simple.

All Chrysler Industrial Engines, from 230 to 413 cubic inches displacement, are engineered and equipped to give years of dependable economical service in oil field use—service requiring little if any supervision.

Chrysler Industrial Engines combine great power with small size—a development of Chrysler's famed continuous research and engineering. Users report exceptional portability with Chrysler Industrial Engines. As a result it is possible to place Chrysler Industrial Engines into hard-to-reach locations.

Finally, oil operators find service and parts availability with Chrysler Industrial Engines is fast, easy to find and inexpensive. A national network of dealers sell and service Chrysler Industrial Engines. There's one near you.

To bring detailed information on Chrysler Industrial Engines or to call in a factory representative, write: ***Dept. 155, Industrial Engine Division, Chrysler Corporation, Trenton, Michigan.***

CHRYSLER INDUSTRIAL ENGINES

INDUSTRIAL ENGINE DIVISION • CHRYSLER CORPORATION

HORSEPOWER WITH A PEDIGREE

J&L STEEL

Midwest

WELDING FITTINGS

MIDWEST Welding Fittings made of easy-to-weld JALTEN are ideal for use with the new high-tensile, high-yield pipe now being placed in oil and gas transmission service.

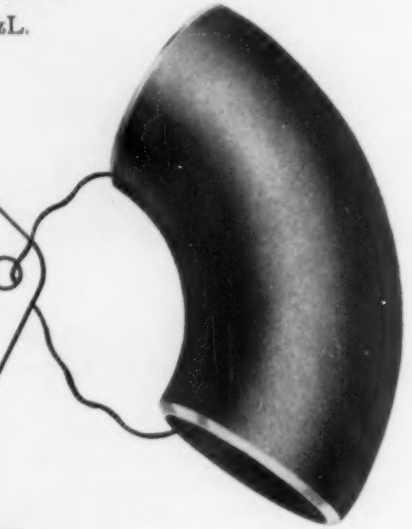
JALTEN is a new low-alloy high-strength steel made by J&L.

JALTEN PHYSICAL PROPERTIES:

	YIELD POINT P.S.I. MIN.	TENSILE STRENGTH P.S.I. MIN.	ELONGATION IN 2", % MIN.
Jalten #1	50,000	65,000	22
Jalten #2	50,000	70,000	22

CHEMISTRY	C	M	P	S	Si	Cu.	V.
Jalten #1	.15 Max.	1.30 Max.	.04 Max.	.05 Max.	.10 Max.	.30 Min.	.035/.065
Jalten #2	.15 Max.	1.40 Max.	.14 Max.	.05 Max.	.10 Max.	.30 Min.	———

Jalten #2 Equivalents: SAE 950
ASTM-A242-49T



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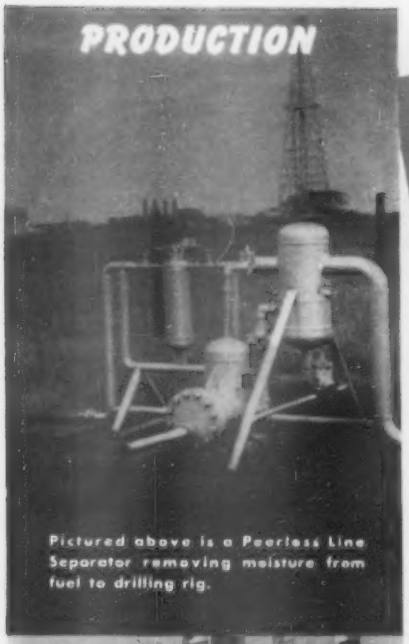
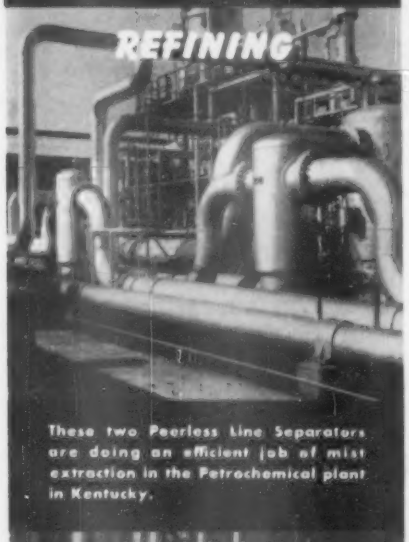
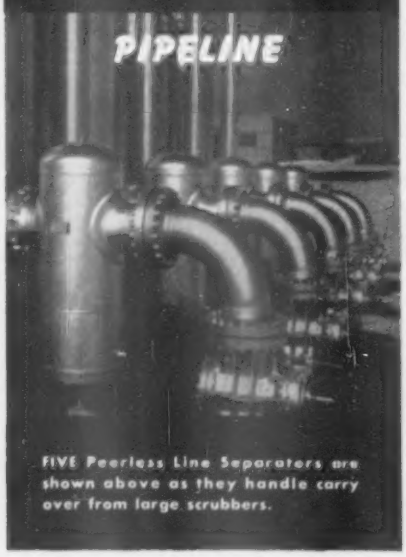
Serving The United States and Canada



Pictured above is a Peerless Line Separator removing moisture from fuel to drilling rig.



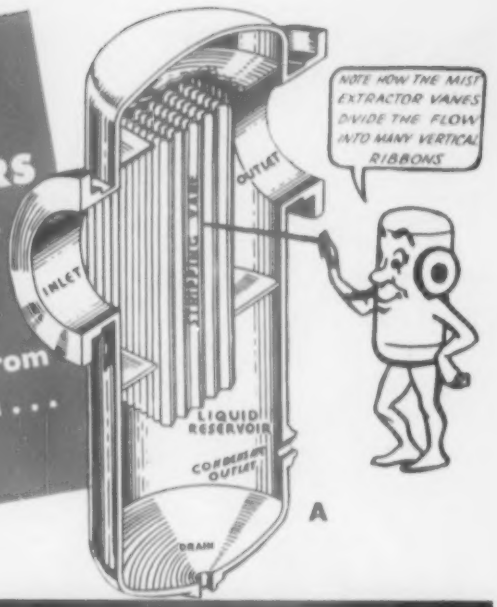
These two Peerless Line Separators are doing an efficient job of mist extraction in the Petrochemical plant in Kentucky.



FIVE Peerless Line Separators are shown above as they handle carry over from large scrubbers.

PEERLESS LINE SEPARATORS

Outstanding for the efficient extraction of liquid mist from gas or steam . . .



HIGH EFFICIENCY — HIGH CAPACITY LOW PRESSURE DROP

Thousands of installations throughout the oil industry . . . production, pipeline, refining and petrochemical . . . prove the Peerless Line Separator principle to be one of the most outstanding methods available for the extraction of liquid gas, steam or air.

Drawing A above shows the arrangement of the vanes in the Separator. Drawing B is an illustration of the Peerless Principle.

The mist extractor combines the forces of impingement, centrifugal motion and surface tension to obtain its high efficiency. The path of the gas, etc., through the unit is constantly bending causing semi-violent turbulence and rolling of the gas against the walls of the vane. Impingement and centrifugal force combine to contact the droplets with the vanes, where they coalesce, and surface tension then causes them to cling to the vane's surfaces. Gravity and the impact of the gas steam then drive the droplets into the pockets where they roll down the vanes and out of the gas stream.

Through the Peerless method of mist extraction, the gas is stripped dry long before reaching the end of the vanes.

there's A PEERLESS SEPARATOR FOR EVERY REQUIREMENT

For any capacity
For any working pressure
For corrosive conditions
With removable vane units
With extra body length
With connections for accessory equipment
For pressure drop requirements of less than 6" water
For any vapor-liquid ratio
For any piping requirement

SPECIAL DESIGN SEPARATORS FOR ANY REQUIREMENT

FOR FURTHER INFORMATION ON THE USE OF PEERLESS LINE SEPARATORS PLEASE WRITE FOR NAME OF NEAREST PEERLESS ENGINEER.

PEERLESS MFG. CO.

PEERLESS MANUFACTURING CO.

P. O. BOX 13165 ★ DALLAS 20, TEXAS ★ Dixon 8431

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AVAILABLE JOHNSTON by AL CAPP

STOP!!
IT'S CROOL T' STUFF THAT CRITTER IN A HOLE!!
WE HEARS CATS' WHISKERS MEASURES OIL-WELL INSIDES!!-
NO!!-YOU HEARD THE JOHNSTON HYDRAULIC HOLE CALIPER IS THE CAT'S WHISKERS, FOR CHARTING BORE-HOLE DIAMETERS!!
IT LOGS SUB-SURFACE FORMATIONS, TO GIVE AN ACCURATE PROFILE-
SPEAKIN' O' PROFILES, YO' JOHNSTON BOYS GOT MIGHTY HAN'SOME ONES!!-
SORRY!!-WE GOTTA LOG A WELL, WIF THAT CALIPER THAT SAVES RIG-TIME!!

C-5411

Copr. Capp Enterprises 1954

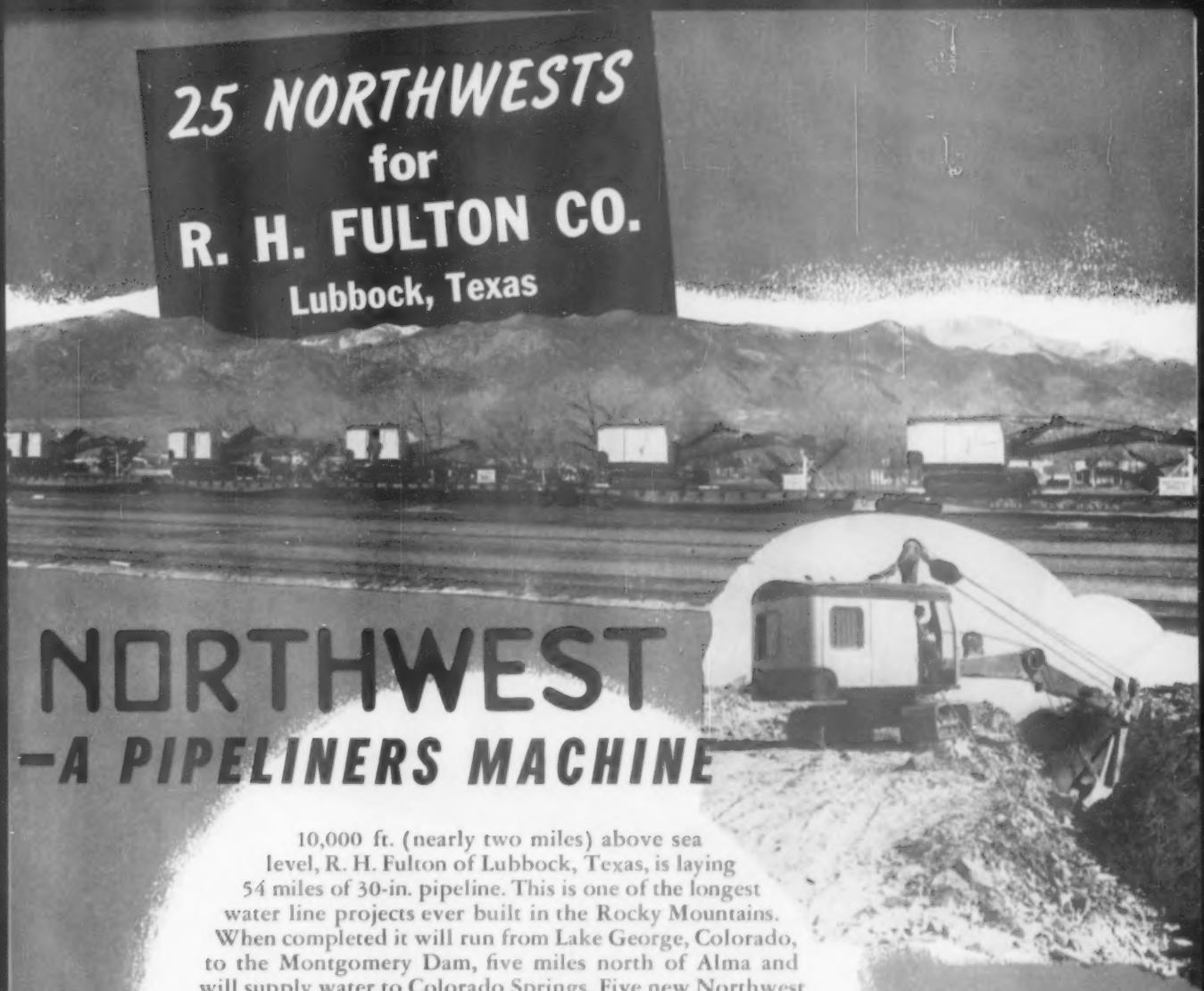
JOHNSTON TESTERS

first in drill stem testing

HOUSTON, TEXAS

LOS ANGELES, CALIF. • CALGARY, CAN.

FORMATION AND JOHNSTON CASING TESTING



NORTHWEST
—A PIPELINERS MACHINE

10,000 ft. (nearly two miles) above sea level, R. H. Fulton of Lubbock, Texas, is laying 54 miles of 30-in. pipeline. This is one of the longest water line projects ever built in the Rocky Mountains. When completed it will run from Lake George, Colorado, to the Montgomery Dam, five miles north of Alma and will supply water to Colorado Springs. Five new Northwest Model 41's, four pullshovels and one crane, recently arrived for the job. These five Northwests make 25 Northwests that have been purchased by the Fulton organization.

From desert to high altitudes, R. H. Fulton & Co. have proved Northwest equipment and know that it is the solution to their problem.

Take a leaf from the men who know. Remember, one out of every three Northwests sold is a repeat order. You may not have mountain work to do but *you do want* dependability. Northwest has it for you! Ask for more complete details.

NORTHWEST ENGINEERING CO.
1517 Field Bldg., 135 South La Salle St.
Chicago 3, Illinois

Top: Five Northwests arriving at Colorado Springs for R. H. Fulton Co.
Below: Look at that digging! One of the many tough pipeline jobs on which Northwests have proved their reliability both for digging and for travel.

NORTHWEST

CRAWLER and TRUCK MOUNTED SHOVELS • CRANES • DRAGLINES • PULLSHOVELS

NORTHWEST ENGINEERING COMPANY
135 South La Salle Street, Chicago 3, Illinois

Please send me complete information and catalogs on equipment as checked:

☐ Shovel ☐ Crane ☐ Dragline ☐ Pullshovel
☐ Truck Crane Capacity _____

Name _____
Address _____
Town _____ Zone _____ State _____
Signed _____

NOW...for greater safety

APPLETON

Explosion-Proof! Dust-Tight! Rain-Tight!

CIRCUIT BREAKER, MOTOR STARTER and COMBINATION MOTOR STARTER

UNILETS

REG. U.S. PAT. OFF.

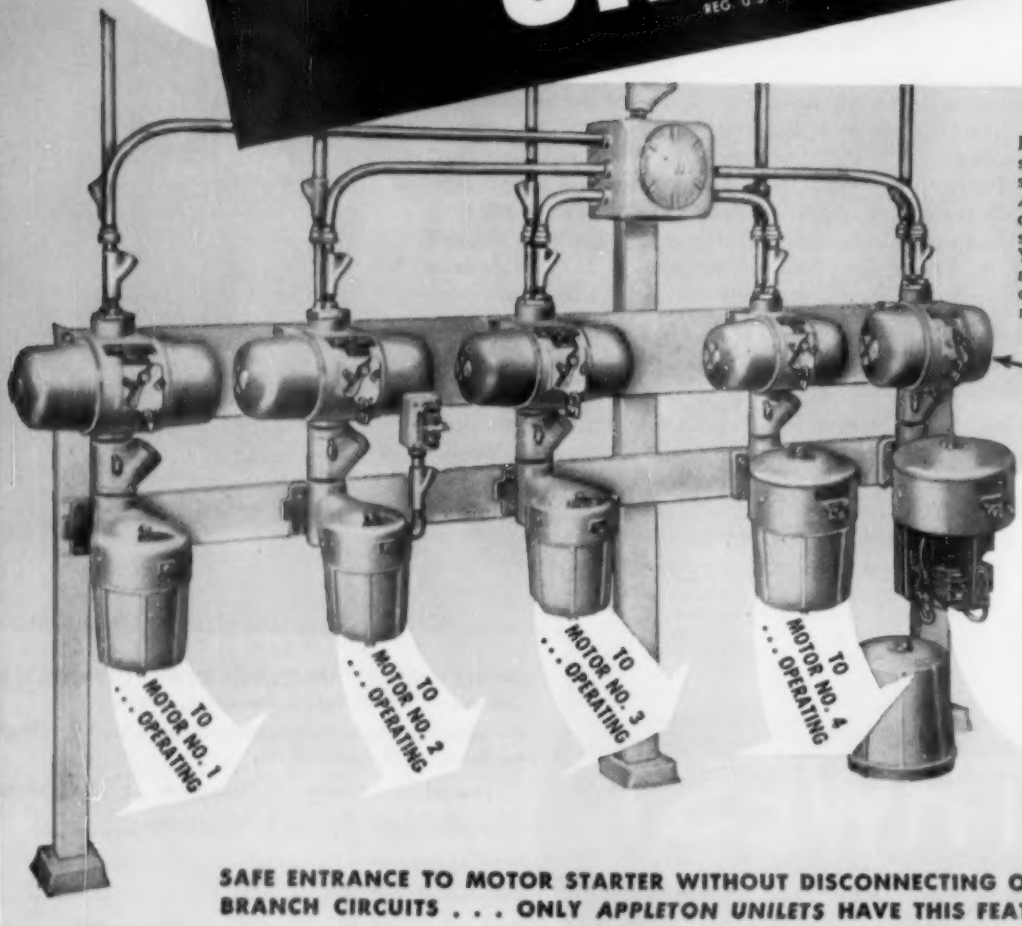


Illustration shows the high safety factor, versatility, and space-saving attributes of *Appleton* explosion-proof circuit breaker and motor starter *Unilet* Combinations. Your own installation needs, no matter what they may be, can also be met with these remarkable new Unilets.

BREAKER LOCKED IN "OFF" POSITION

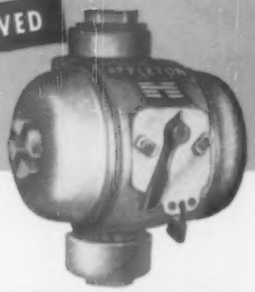
MOTOR STARTER NO. 5 . . . EXPOSED FOR SAFE MAINTENANCE . . .

but no "down time" on other operating equipment

SAFE ENTRANCE TO MOTOR STARTER WITHOUT DISCONNECTING OTHER BRANCH CIRCUITS . . . ONLY *APPLETON UNILETS* HAVE THIS FEATURE!

Signed

U. L. APPROVED



"CB" Circuit Breaker UNILETS

Assure easy, safe, flexible, and economical installation for protection of service entrance, feeder or lighting, appliance, and branch circuit conductors up to 225 amperes. U. L. Approved individually and in banked groups up to three for forms 1 and 2 without using dividing seal.

U. L. APPROVED

Sealing UNILETS

Available for use as explosion-proof seal where needed on circuit breaker and motor starter Unilets. This Sealing Unilet is furnished on all Combination Motor Starters, and when properly sealed permits safe entrance to a motor starter in single or banked combination installations, without disconnecting other branch circuits.

U. L. APPROVED

"LS" Motor Starter UNILETS

For 3-phase induction motor control up to 100 H.P. at 600 volts maximum. Lightweight construction of larger sizes eliminates need for heavy lift equipment . . . assures easy, time-saving, inexpensive installation. Also made for reversing and two-speed motors.

The greatest advance in explosion-proof design in years!

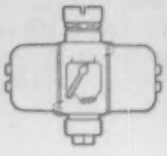
You expect more from *Appleton*, and you get it! The proof lies in these completely new and different *Appleton* circuit breaker and motor starter *Unilets*. Alone or in combination, their design, construction, and performance give you maximum safety, unparalleled ease of wiring, installation and maintenance, and initial and long-term money savings not available with any other equipment! You'll find their exclusive features invaluable on any hazardous-location motor control or power lead-in installation, large or small, indoors or outdoors, where tricky wiring, corrosive and flammable atmospheres, dust, or weather difficulties appear insurmountable. Where absolute safety is required day in and day out and every minute of the day, you can place complete confidence in *Appleton Unilets*.

IMPORTANT ADVANTAGES

- **FIRST to be U. L. Approved for BANKED Circuit Breaker Grouping**
- **Combinations Meet U. L. Requirements through Approval of Components**
- **FIRST to Achieve Safe Entrance to Motor Starter of a Combination without Shutting Off Other Branch Circuits**
- **Full 7-Thread Explosion-Proof Protection . . . No Bolts to Strip or Flanges to Nick**
- **Unmatched Accessability for Easiest Wiring and Servicing on Every Job**
- **Light-Weight Construction for Easy Installation without Heavy Lift Equipment**
- **Quick Interchange on All Leading Makes of Circuit Breakers and Motor Starters**
- **Flexible Field Set-ups Assured with Single and Duplex Male and Female Hub Adapters**

BANKED CIRCUIT BREAKER GROUPING

Male to female hubs permit easy grouping. Cuts costs, streamlines panel set-ups, assures coordinated control without sacrificing safety. U. L. Approved up to groups of three in smaller size Unilets.



OVER-SIZE CONDUIT and CONDUCTORS

May be run with hub adapters for subsequent installation of higher rated breakers without replacing complete Unilet or existing conduit.

VERTICAL "STRAIGHT-THRU" DESIGN

Simplifies wire pulling, saves time. Ample working space eliminates need to remove breaker mechanism from enclosure, yet assures clean, safe wiring.

Patent Applied For

PUSH-BUTTON and PILOT DUTY CONTROL

Combines convenience and selectivity including built-in "Start-Stop," "Hand-Off-Auto.", or "Jog-Run-Off" control where needed.

Sold Exclusively Through Selected Wholesalers

APPLETON ELECTRIC COMPANY

1718 Wellington Avenue, Chicago 13, Illinois

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Explosion-Proof Fixtures

Industrial Lighting

"ST" Liquid-Tight Connectors

Automatic Reelites

Outlet Boxes, Covers, Switch Boxes

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A complete catalog section containing informative technical data.

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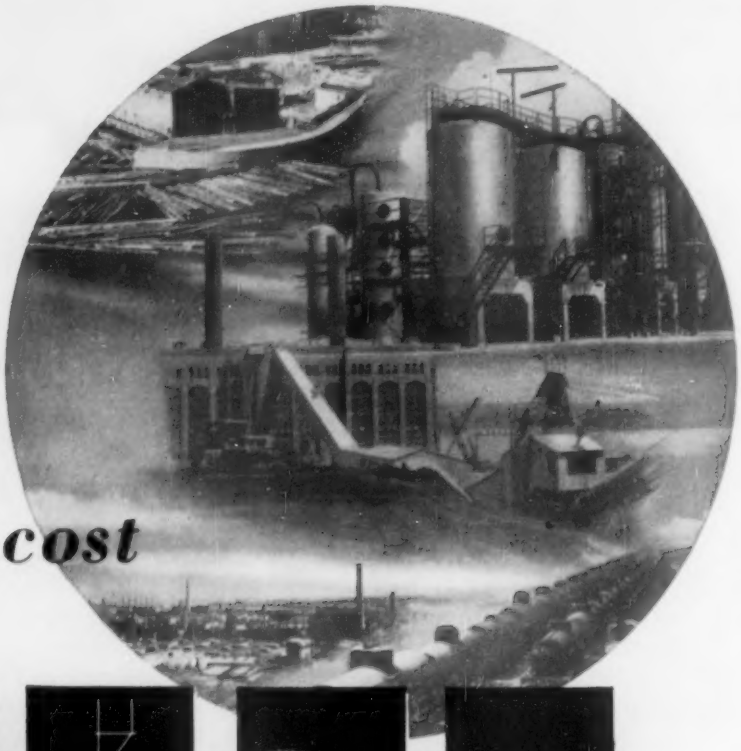
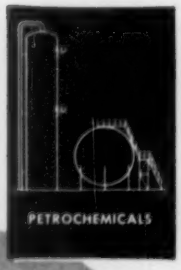
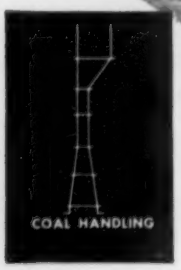
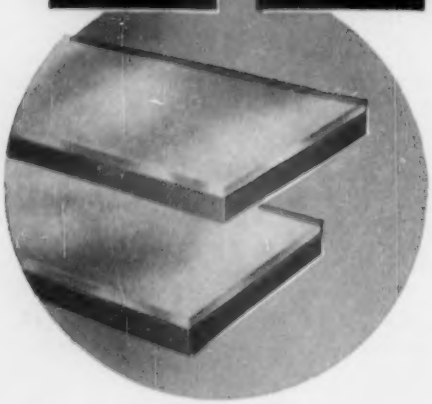
how to get Stainless Steel advantages ...*at lower cost*









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For numerous types of tanks, vessels and processing equipment, Claymont Stainless-Clad Plates give all the advantages of solid stainless steel—yet with substantial savings.

Produced in our plant to exacting standards, these plates are manufactured with painstaking care under personalized supervision. Our facilities provide definite assurance of prompt delivery. For detailed information write direct to Claymont Steel Products Department, The Colorado Fuel and Iron Corporation, 813 West Street, Wilmington 99, Delaware.

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CF&I

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Explosion-Proof Fixtures

Automatic Reelites

Covers, Switch Boxes

Rely on APPLETON ... *The Standard for Better Wiring*

THE PROOF IS IN THE FIELD....

Carter

Long-stroke Hydraulic Pumping Units

Featuring the amazing Variable-Cycle Principle

Designed — Built — Priced FOR STRIPPER WELLS

CALIFORNIA

Carter Unit Pumping In Edna Field. Has been in service for seven years.

KANSAS

One of 4 units in the Great Bend Area, pumping from 3400 ft., owned by large independent.

EAST TEXAS

One of 4 Carter Units owned by a major oil company in Kilgore and Turnertown Areas. Pumping allowable from 2300 ft. Total cost about 60% of the cost of a conventional unit

OKLAHOMA

One of seven units owned by an independent in the Tulsa Area, pumping from about 1300 ft. Operator reports production holding up better than offsetting wells with conventional units.

KENTUCKY

Carter Unit on 13-ft. substructure in the Green River Bottoms. Operator saved about 50% on substructure cost alone. This is one of seven units owned by this independent.

NORTH TEXAS

Major oil company installation in Cooke Field, pumping 30 bbl/day from 6250 ft. Its rod fortune is more than 6 years operation. Total cost about 50% of the cost of a conventional unit

CANADA

Carter Unit operating in 50 degree-below-zero weather in the Carbondale Field, showing adaptability of Carter Unit to extreme climatic conditions

SOUTH TEXAS

Production increased from 8½ bbl/day to 6 bbl/day on this 2700-ft. well in the Duval County Area, when it replaced conventional equipment. This is one of 11 units owned by this independent.

WEST TEXAS

Carter Unit in the Spraberry Area, pumping from 7186 ft. This unit was installed for about 30% of the cost of a conventional unit.

MORE THAN 800 UNITS NOW IN SERVICE!

MORE THAN EIGHT YEARS OF FIELD EXPERIENCE!

From Canada to the Gulf, from Ohio to the Pacific, Carter Long-Stroke Hydraulic Pumping Units are saving thousands of dollars, for majors and Independents alike, through lower first cost and maintenance as well as increasing production in many cases.

WRITE FOR BULLETIN PR-355

S. C. CARTER COMPANY, inc.

1900 Santa Fe Avenue • Los Angeles, California

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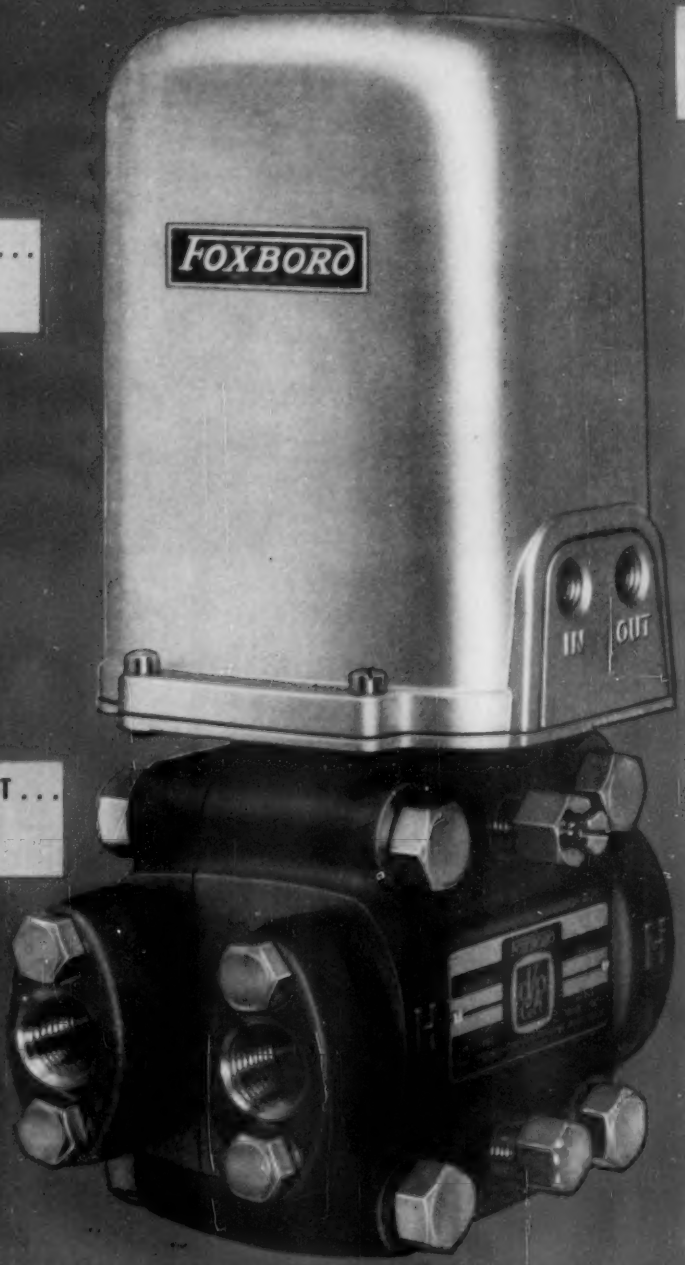
EXPORT: COLOMBIA and VENEZUELA—Weiss S. A., Caracas, Maracaibo and Puerto la Cruz.

NEW Advanced Design...

NEW HIGH SUSTAINED ACCURACY . . .
even under extreme operating and ambient conditions

NEW CONVENIENT ZERO ADJUSTMENT . . .
external—no need to remove weather-proof cover



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NEW POSITIVE OVERRANGE PROTECTION . . . up to full 1500 lbs. cell rating

6 Major Achievements!

NEW FULLY ADJUSTABLE RANGE . . . from 0-50" to 0-250" H_2O differential

NEW AUTOMATIC INTERNAL DAMPING . . . fast, stable measurement

NEW SIMPLICITY . . . lowest cost installation

Pioneered by Foxboro 7 years ago, the d/p Cell* Transmitter established a new standard of performance in flow measurement and control. Over 40,000 are maintaining that standard in every branch of industry today. Technical advances, based on this unequalled experience, now have added even further reliability, economy and convenience. Call your Foxboro representative for a demonstration. Write for new Bulletin 13-11.

*Reg. U. S. Pat. Off.

FOXBORO
REG U S PAT OFF

first in flow measurement

THE FOXBORO COMPANY, 605 NEPONSET AVE., FOXBORO, MASS., U.S.A.

INSTANT POWER

for dependable ignition

AMERICAN BOSCH MAGNETOS

Better to start with—best in the long run. That's the power-packed story of American Bosch Magnetos . . . today's finest ignition units. Many advanced features give them greater power for split-second starting and premium engine performance PLUS built-in stamina that assures years of constant, trouble-free service in your Drilling, Producing, Pipe-Line and Refinery equipment. That's why they're so widely used as original equipment by many leading engine builders.

For your every replacement need—from the largest, heavy duty engines with either high or low tension ignition, down to today's compact, high-speed power units—there's an American Bosch Magneto precisely engineered for maximum efficiency at all operating speeds and loads. Moreover, American Bosch gives you all the advantages of one of the world's largest and most efficient Magneto Service organizations through your nearby AB Service Agency. Write today for application data on your high or low tension ignition engines. American Bosch, Springfield 7, Mass. A Division of American Bosch Arma Corporation.

AMERICAN BOSCH

Automotive and Aviation Magnetos

Generators and Regulators

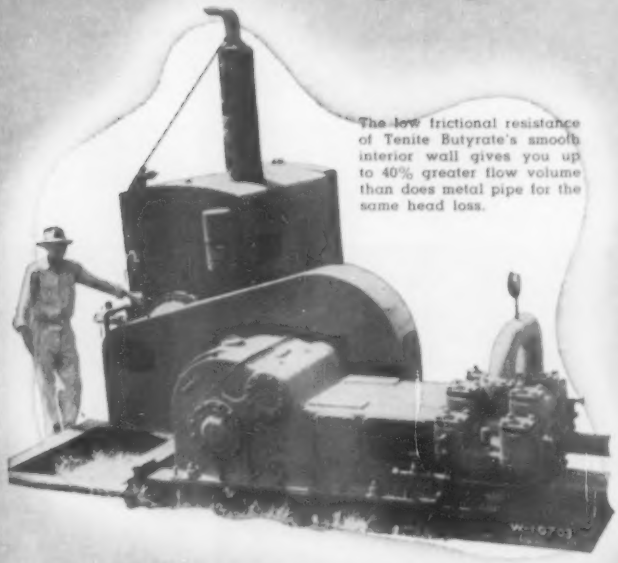
Components for Aircraft Engines

Small Electric Motors

Electric Windshield Wipers

Diesel Fuel Injection Equipment

Butyrate pipe means less load on pumps

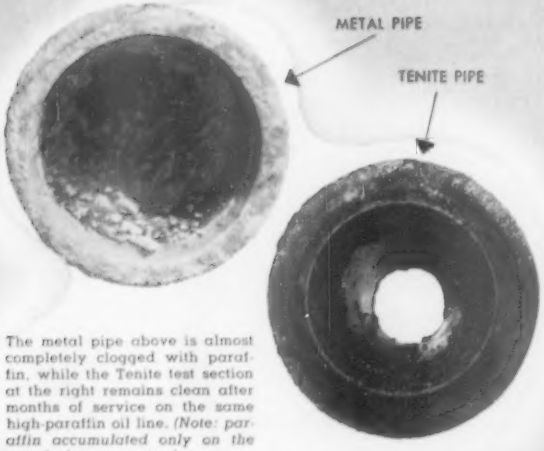


The low frictional resistance of Tenite Butyrate's smooth interior wall gives you up to 40% greater flow volume than does metal pipe for the same head loss.

Butyrate pipe means less maintenance

You can bury Tenite Butyrate pipe without corrosion worries. Tenite resists corrosion by sour crudes, salt water and electrolytic soils.

Butyrate pipe means less downtime



The metal pipe above is almost completely clogged with paraffin, while the Tenite test section at the right remains clean after months of service on the same high-paraffin oil line. *(Note: paraffin accumulated only on the metal pipe connector.)*

What problems could Tenite Butyrate lessen for you?

TENITE BUTYRATE PIPE ends many of the troubles you encounter with metal pipe. For example, using Tenite, you can quickly cross off corrosion failures. If paraffin accumulation has been your problem, you'll find that few, if any, cleanings are necessary when your paraffin-laden crudes are sent through Tenite lines.

Does your pipe have to be hauled over long, difficult distances? Then, you'll like the light weight of Tenite – it is only 1/12th as heavy as the cement-lined metal pipe you may now be using. Tenite even helps your pumping costs, lets you use smaller pumps and less power. Best of all, Tenite is the easiest pipe to install. You just solvent weld slip-sleeve couplings to the pipe ends.

Look into the record of Tenite Butyrate pipe in oil field service. Our technical staff will give you full information and help you adapt Tenite pipe to your operations. EASTMAN CHEMICAL PRODUCTS, INC., Kingsport, Tenn., subsidiary of Eastman Kodak Company.

TENITE
BUTYRATE
an Eastman plastic

EASTMAN CHEMICAL PRODUCTS, INC.
KINGSPORT, TENNESSEE

Please send me information on TENITE BUTYRATE PIPE and a list of companies manufacturing Tenite pipe and fittings.

NAME _____
POSITION _____
COMPANY _____
STREET _____
CITY _____ STATE _____
OGS-55

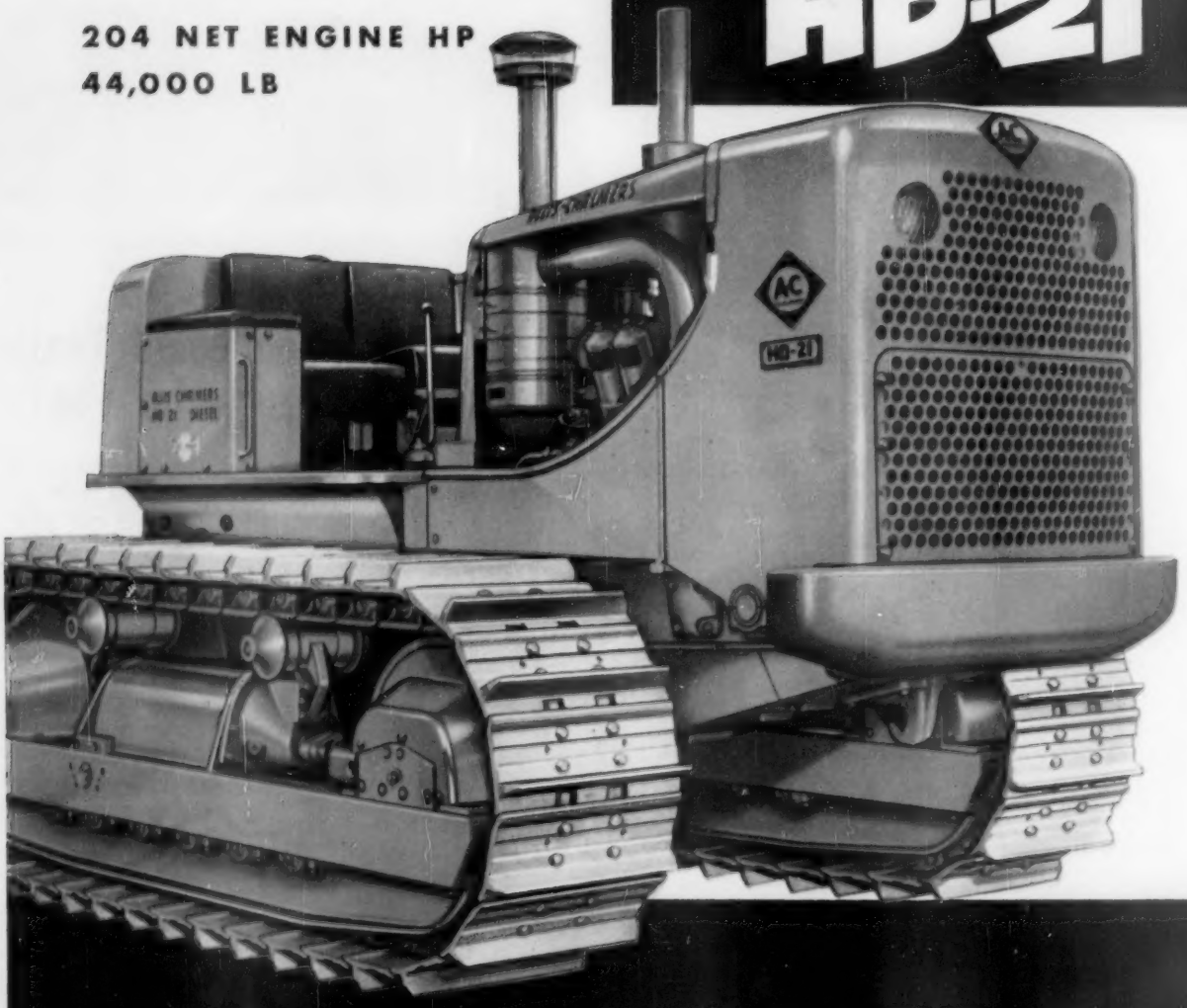
To meet the stepped-up needs of industry . . .

ALLIS-CHALMERS PRESENTS THE POWERFUL CRAWLER IN

ALLIS-CHALMERS

HD-21

204 NET ENGINE HP
44,000 LB



Nowhere can you match the HD-21
in the amount of work it will do!

. . . for more power—better performance—longer life . . .

BIGGEST, MOST PRODUCTION ANYWHERE!

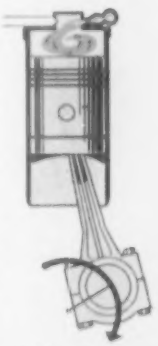
New standards of output The HD-21 introduces the new Allis-Chalmers engine and a great new power team. Together, they provide extra speed with any load, extra pulling power at any speed . . . wider speed ranges and more range overlap. And with its advanced design torque converter (*the result of 15 years of leadership by Allis-Chalmers*) the HD-21 puts its power to work with less shifting than ever before possible . . . to help you reach a new high in efficient, profitable production!

New standards of durability From the new Allis-Chalmers diesel with "follow-through" combustion to new, heavier Tru-Dimension track, the HD-21 is built to take today's big loads in stride, and come back for more. Here are just a few more of the long-life features you can't get from anyone but Allis-Chalmers . . . at any price: all-steel Box-A main frame, straddle-mounted final drive gears, 1,000-hour truck wheel lubrication, oil-enclosed track release mechanism.

New low cost per unit of work The HD-21 offers 20 percent greater over-all performance . . . provides a new measure of tractor value. Add the *planned* approach to service offered by Allis-Chalmers dealers, and it's the ideal team for men tackling today's *big* jobs.

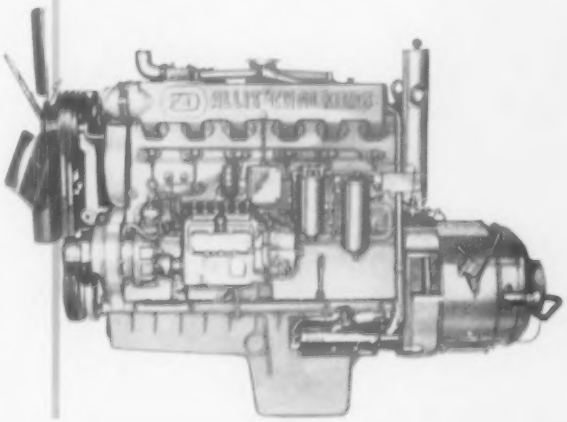
Here's one of the HD-21's many new features—

New Allis-Chalmers engine



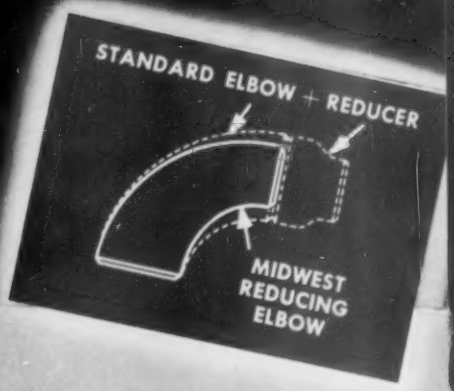
Brings you top performance, extra-long life through a new kind of "*follow-through*" combustion. Here's why—

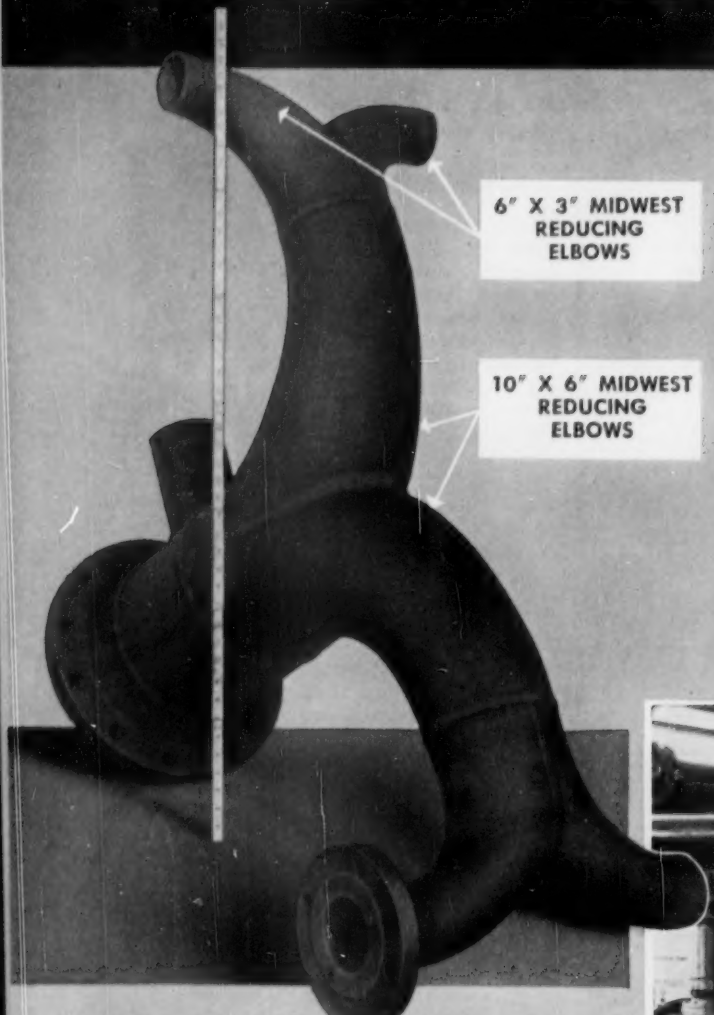
The key explosion occurs in the energy cell as shown, unleashing a blast that sets up cyclone turbulence. Result—no damaging peak pressures . . . instead, higher average working pressures and better leverage on the crankshaft. *Be sure to ask your Allis-Chalmers dealer for the visual story revealing the full advantages of this new engine.*



SEE YOUR **ALLIS-CHALMERS** DEALER

Better Piping at a Better Price by Using MIDWEST REDUCING ELBOWS



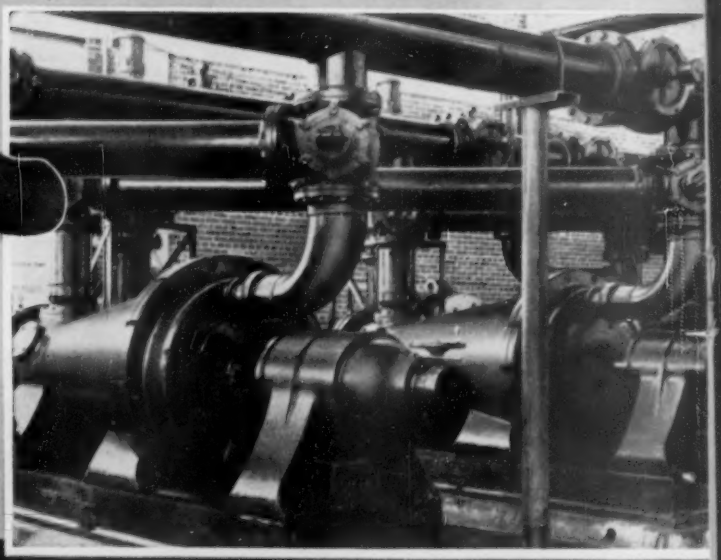


The Midwest Reducing Elbow offers important advantages in both piping design and piping cost. It needs only two welds instead of the three required by a standard elbow and a reducer (see sketch above). There is also a saving in layout time. Turbulence and pressure drop are reduced by the gradual taper . . . less space is needed . . . insulation is easier . . . and piping appearance is improved.

Only Midwest Reducing Elbows are available from stock in sizes to 16" . . . larger on special order. They have the same dimensional accuracy, uniformity of wall thickness, exact included angle and true center-to-end dimensions of Midwest Straight Elbows. For further information, ask for Catalog 54.

699

Midwest Reducing Elbows made it possible to fabricate this transformation piece for a boiler feed suction line so that it could be installed in the limited space available and still get the benefit of streamline flow. There was also a cost saving in comparison with a less efficient and bulky assembly made with straight tees, ells and reducers.



Paper stock flows with minimum resistance through Midwest Reducing Elbows from 8" connection on Jordan to 10" header. Other advantages over standard elbow and reducer: a saving in cost and space, and improved appearance.

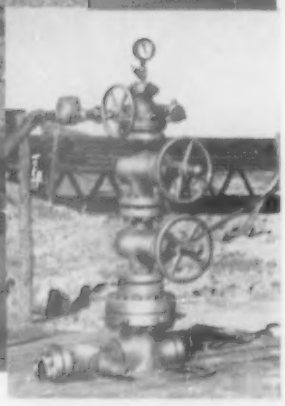
MIDWEST WELDING FITTINGS
Improve Piping Designs
and Reduce Costs

MIDWEST PIPING COMPANY, INC.

Main Office: 1450 South Second Street, St. Louis 4, Mo.

Plants: St. Louis, Passaic, Los Angeles and Boston

WELL-HEAD PUNISHMENT



won't impair sealing efficiency or operating ease of

GROVE SEAL-"O"-RING GATE VALVES

Grove "Christmas trees" in every major producing area have proved the important fact that rocks, mud, sand and other foreign matter are carried through these full-opening Seal-"O"-Ring valves during the cleanout period without damaging gate or seat—without impairing the characteristic ease of operation provided by the parallel-sided free sliding port plate. Scraping action of the metal seat, and squeegee effect of the "O" ring seals, clean and polish the gate with each operation, maintaining absolute bubble tight seal. Small wonder that many important producers are already specifying Grove Seal-"O"-Ring Gate Valves for every new and replacement well-head application. Get full details today.

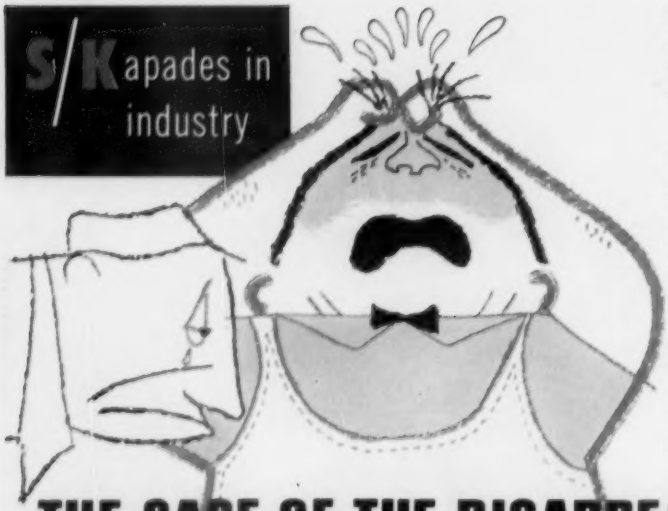
501

GROVE SEAL-"O"-RING Gate Valves

GROVE VALVE and REGULATOR COMPANY • 65th & Hollis Sts., Oakland 8, California
HOUSTON 4—1901 Calumet St. • • • • • • • • **LOS ANGELES 6**—1930 W. Olympic Blvd.

ODESSA, TEX. • TULSA, OKLA. • LAFAYETTE, LA. • CHICAGO, ILL. • DENVER, COLO. • In Western Canada: GROVE VALVE LIMITED

S/K apades in industry



Buck, the Boss Boiler Expert, had red hair and a vivid green complexion. The complexion came from biliousness—caused by disappearing tube bundles in acid-oil and liquid-sludge heaters.

"Wurrrp!" said Buck to his Assistant. "Another tube bundle chawed up by corrosion. We work night and day installing new tubes, sheets and baffles—and they disappear like pie at a picnic."

"And management keeps squawking about heater downtime," said the Assistant. "*And* overtime. *And* retubing costs. Boy, is your face green!"

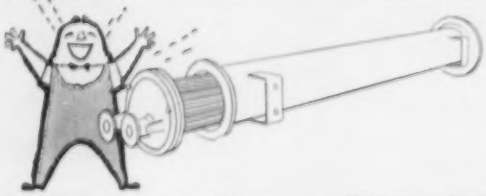
"Beeeep!" said Buck. "Yours will be red if we don't find a way to lick this corrosion problem."

"I think there *is* a way," soothed the Assistant. "Let's go look at a catalog I just got from Schutte and Koerting."

THE CASE OF THE DISAPPEARING TUBE BUNDLES AND THE BILIOUS BOILER EXPERT

Schutte and Koerting Bulletin HT-1, "SK Heat Transfer Apparatus," told Buck just where he could get information about various types of tube bundles. Special materials, sizes, types and modifications—all were covered. "Let's suggest that management call an SK Sales Engineer," said Buck.

The SK Sales Engineer arrived on the double. He took a good look at the corroded tube bundle, asked some pointed questions about materials to be handled, and made some recommendations that caused even the Big Brass to applaud.



CORROSION CONQUERED—BILIOUSNESS BEATEN.

At the SK Engineer's suggestion, new tube bundles of Copper-Silicon Alloy replaced the old bundles in liquid sludge heaters. Result: long, trouble-free operation in processing highly corrosive stock—far less downtime and lower retubing costs—a brand new complexion, not even tinged with green, for Buck, the Boss Boiler Expert!

MORAL: *Send today for your free copy of SK Bulletin HT-1 on Heat Transfer Apparatus. And for skilled help with a specific problem, call in a specialist—your nearest SK Sales Engineer.*

Schutte and Koerting
COMPANY
MANUFACTURING ENGINEERS

2219 STATE ROAD, CORNWELLS HEIGHTS, BUCKS COUNTY, PA.

Jet Apparatus • Heat Transfer Equipment
Strainers • Condensers and Vacuum Pumps
Oil Burning Equipment • Rotameters
Flow Indicators • Radiation Tubes • Valves
Spray Nozzles and Atomizers • Gear Pumps
Desuperheaters

NEW

MID-CONTINENT SUPPLY CO.
Exclusive Oil Field Distributors
—Domestic and Export

VERY HIGH STRENGTH

15% STRONGER
THAN IMPROVED PLOW STEEL

SIZE FOR SIZE the new VHS wire rope developed by American Chain & Cable Company is at least 15% stronger than Improved Plow Steel, which has been the standard grade of the wire rope industry.

FOR DEEPER DRILLING the extra strength of Tru-Lay VHS provides additional weight lifting capacity in the same diameter of wire rope.

LONGER LIFE MEANS LESS COST The ability of VHS to withstand shock and abrasion to a greater degree than any other grade means a longer lasting rope.

Available NOW through all Mid-Continent Stores

PESA

ACCO

Product of
American Cable
Division
American Chain &
Cable Co.
Wilkes-Barre, Pa.

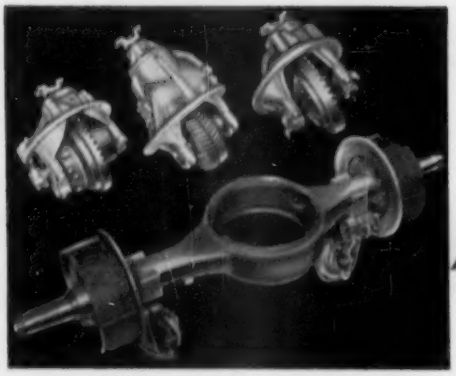
MID-CONTINENT Supply Company

MID-CONTINENT BLDG. FORT WORTH, TEXAS

THE WORLD'S LARGEST INDEPENDENT OIL FIELD SUPPLY COMPANY

EATON AXLES

Proven Performance in Every Type and Size



The rugged housing used in famous Eaton 2-Speeds is also used for Eaton single-reduction and double-reduction axles—the three heads are interchangeable.

Behind every Eaton Axle there is almost a half-century of truck axle manufacturing experience. The advanced engineering and quality construction which have made Eaton 2-Speeds famous for stamina and low-cost hauling are also found in Eaton single-reduction, double-reduction, tandem drive axles, and front axles. In more than two million motor trucks, Eaton experience and engineering know-how are reflected in outstanding performance records, minimum hauling costs, and longer vehicle life.

EATON — **AXLE DIVISION**
MANUFACTURING COMPANY
CLEVELAND, OHIO

PRODUCTS: Sodium Cooled, Poppet, and Free Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Rotor Pumps • Motor Truck Axles • Permanent Mold Gray Iron Castings • Heater-Defroster Units • Snap Rings Springtites • Spring Washers • Cold Drawn Steel • Stampings • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers

Factory-Assembled Lineup Offers

5 Important Advantages

1. **Centralized Control** — All high voltage control for an entire department or plant may be concentrated in one place. When located in a separate control room, starter lineup operates in cleaner atmospheres. It also may be made inaccessible to unauthorized personnel.

2. **Low-Cost Installation** — Control group is factory-assembled *and bussed*. Conduit layout is greatly simplified. For example, lineup requires only one incoming power feeder.

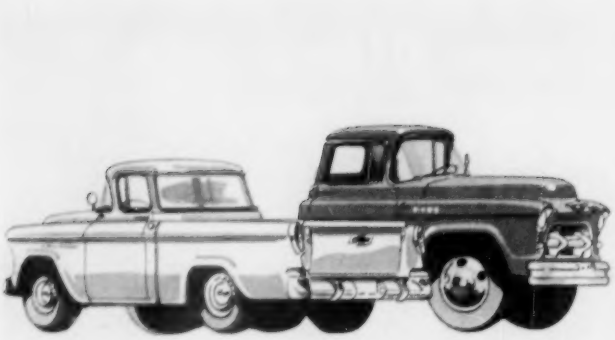
3. **Simplified Expansion** — Internal bus and convenient wiring provision plus standardization of cubicle size facilitate addition of starters. Each starter unit is self-contained. Expanding the lineup is merely a matter of adding a starter and connecting the bus.

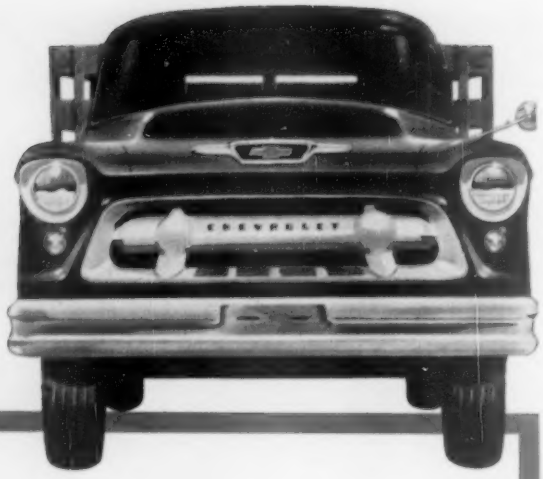
4. **Attractive Appearance** — Uniformity of cubicles presents a modern, streamlined appearance.

5. **One-Company Responsibility** Complete responsibility for assembling proper control devices and for control performance rests with Allis-Chalmers. A-4704

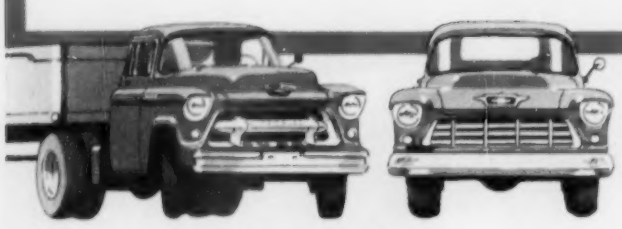
For complete information, see your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin.

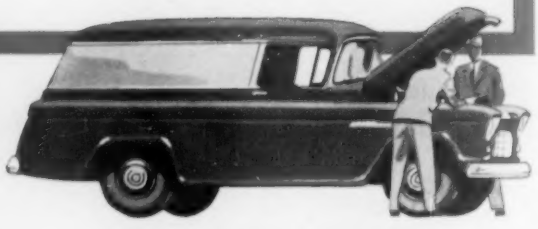
ALLIS-CHALMERS





NEW CHEVROLET *Task-Force* TRUCKS



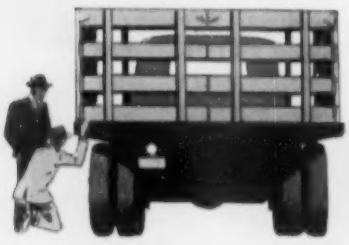


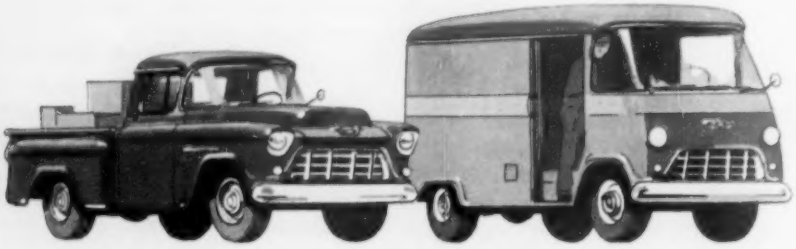
A new kind of truck styling

It's Work-Styling—an exclusive development in truck design with two distinctively different styling treatments. On the job, your truck "looks the part" and becomes a profitable advertisement on wheels for you and your business.

New "high-voltage" engines

Six of them! Each with a modern 12-volt electrical system for surer year-round starts and increased generator capacity—plus a long list of other new advances. They're the last word in smooth, quiet and thrifty truck power.



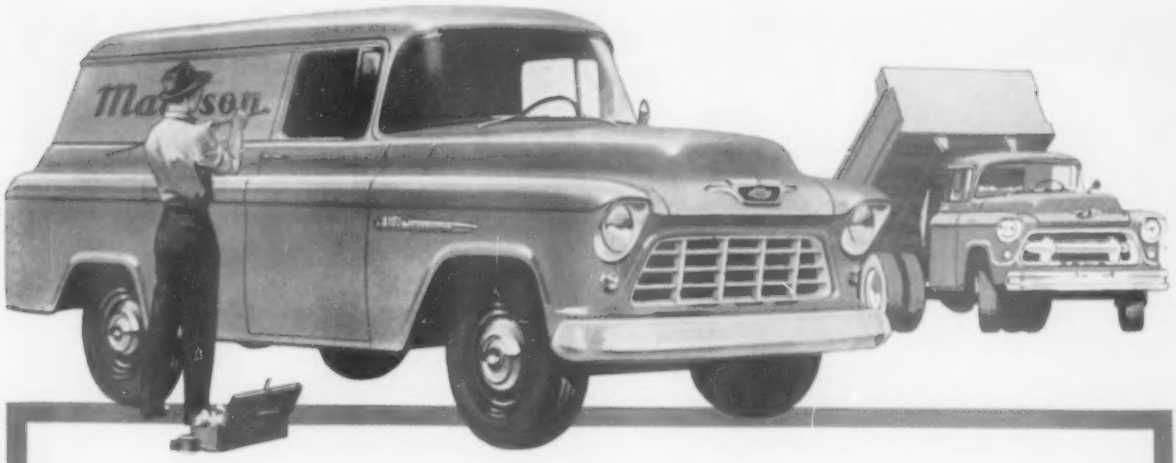


New frames of standard width

All models now have new ladder-type frames with full-length parallel side members for greater rigidity and longer truck life. Now, too, these newly designed Chevrolet frames are all 34 inches wide to accommodate special body installations.

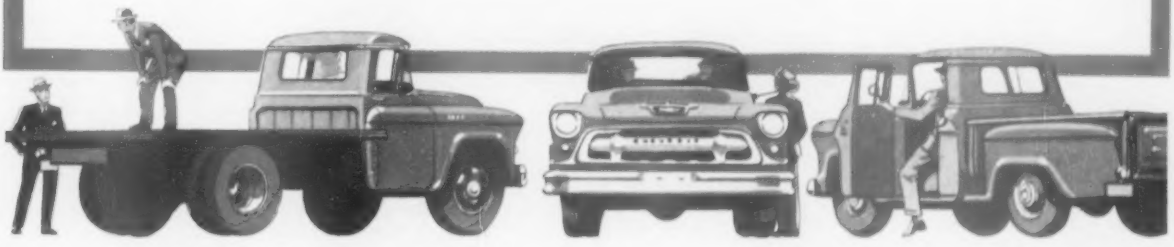
New Overdrive—Truck Hydra-Matic

For even bigger gas savings and less engine wear, new Overdrive is available on all ½-ton models at extra cost. Hydra-Matic, Chevrolet's thrifty automatic truck transmission, is optional on ½-, ¾- and 1-ton models at extra cost.



CHEVROLET

They're setting the pace for the whole industry! Take a good look at them here... in the showroom . . . on the road. It won't take you long to discover that these are the most modern trucks on any job.

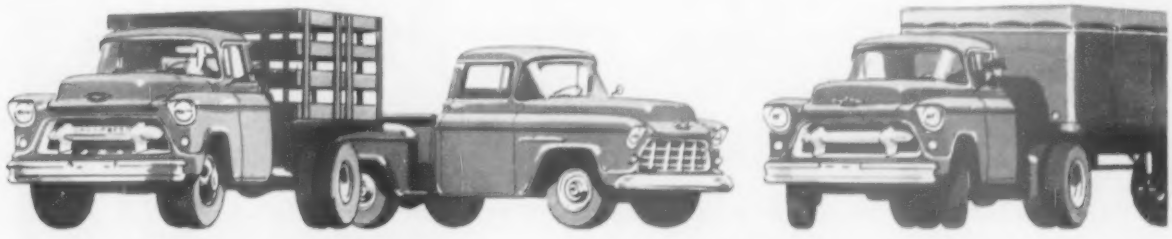


New 18,000-lb. G.V.W. capacity

The highest ever for Chevrolet! And that's good news for everyone with heavy hauling to do. For with this hefty hike to 18,000 pounds Gross Vehicle Weight, Chevrolet brings its famous economy and dependability to new heavy-duty fields.

A cab as new as the view

New Sweep-Sight windshield—plus more glass all around—for a wider, safer view. New High-Level ventilation for greater driver comfort. New softer seats. New, more durable cab construction. New concealed Safety Steps that stay clear in all weather.



Power Brakes standard on 2-ton models

This great power helper increases driving safety . . . reduces driver effort. You stop with up to one-third less pedal pressure—and you do it right now! Chevrolet Power Brakes are standard equipment on 2-ton models —optional at extra cost on all others.

There's more to tell, a lot more

Stop in and let your Chevrolet dealer give you the complete "all-new" story. There are many more good things to discover about the New Chevrolet Task-Force Trucks! . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

CARBIDE

the NAME to keep in mind

...for

MONOETHANOLAMINE
DIETHANOLAMINE
DIETHYLENE GLYCOL
TRIETHYLENE GLYCOL

You get *more* than gas-treating chemicals when you specify CARBIDE . . .

You get these extra benefits...

- the results of CARBIDE's 20 years' experience in the manufacture of amines and glycols.
- the service of CARBIDE's field representatives.
- the assistance of CARBIDE's laboratories where specialists devote a great amount of time to work on customer service problems.
- the benefit of CARBIDE's knowledge about the handling, properties, and use of these chemicals.
- the assurance of availability and fast service through CARBIDE's national distribution network of 50 warehouses. (In Canada: Harrisons & Crosfield's.) Shipments are made in tank cars, tank wagons, and drums in carload or truckload lots.

Remember

You get *more* than chemicals when you specify CARBIDE.

CARBIDE
AND CARBON
CHEMICALS

Carbide and Carbon Chemicals Company
A Division of
Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.

INDUSTRIAL GASOLINE ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
N56	4	2¼	3½	56	14.2 @ 2200 RPM
N62	4	2⅜	3½	62	15 @ 2200 RPM
Y69	4	2½	3½	69	21.4 @ 2400 RPM
Y91	4	2⅞	3½	91	28.5 @ 2400 RPM
Y112	4	3 1/16	3½	112	32 @ 2400 RPM
F124	4	3	4⅛	124	36 @ 2400 RPM
F140	4	3 1/16	4⅛	140	42 @ 2400 RPM
F162	4	3 1/16	4⅛	162	49 @ 2400 RPM
F186	6	3	4⅛	186	60.5 @ 2400 RPM
*F201	4	3⅛	4⅛	201	59 @ 2000 RPM
F209	6	3 1/16	4⅛	209	68 @ 2400 RPM
F226	6	3 1/16	4⅛	226	73 @ 2400 RPM
F244	6	3 1/16	4⅛	244	79 @ 2400 RPM
M271	6	3⅛	4⅛	271	86.2 @ 2400 RPM
M290	6	3¼	4⅛	290	92.2 @ 2400 RPM
M330	6	4	4⅛	330	104.4 @ 2400 RPM
M363	6	4	4 15/16	363	109 @ 2000 RPM
B371	6	4⅛	4⅛	371	110 @ 2400 RPM
B427	6	4 1/16	4⅛	427	127 @ 2400 RPM
G134	4	3¼	4⅛	134	32.2 @ 2000 RPM
G157	4	3⅜	4⅛	157	37.7 @ 2000 RPM
H227	4	3⅝	5½	227	52 @ 1800 RPM
H243	4	3¾	5½	243	56 @ 1800 RPM
*H260	4	3⅞	5½	260	60 @ 1800 RPM
T371	6	4⅛	4⅝	371	119 @ 2400 RPM
*J382	4	4½	6	382	74.2 @ 1400 RPM
T427	6	4 1/16	4⅝	427	140 @ 2400 RPM
U501	6	4½	5¼	501	160 @ 2400 RPM
R513	6	4½	5⅝	513	164.3 @ 2400 RPM
R572	6	4¾	5⅝	572	182.4 @ 2400 RPM
R602	6	4⅞	5⅝	602	191.7 @ 2400 RPM
V603	8	4⅛	4¼	603	240 @ 3200 RPM
S749	6	5⅝	5½	749	217 @ 2200 RPM
S820	6	5⅝	5½	820	237 @ 2200 RPM

INDUSTRIAL DIESEL ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
GD157	4	3⅜	4⅛	157	39 @ 2000 RPM
*ED201	4	3⅝	4⅛	201	45.8 @ 2000 RPM
HD243	4	3¾	5½	243	54.7 @ 2000 RPM
*HD260	4	3⅞	5½	260	59.3 @ 2000 RPM
*JD382	4	4½	6	382	72.5 @ 1600 RPM
TD477	6	4 1/16	4⅝	427	106.5 @ 2000 RPM
RD572	6	4¾	5⅝	572	142.5 @ 2000 RPM
VD603	8	4⅛	4¼	603	182 @ 2800 RPM
SD802	6	5 5/16	5½	802	202 @ 1800 RPM

*Available for industrial applications only.

CONTINENTAL POWER IS *Specialized Power*

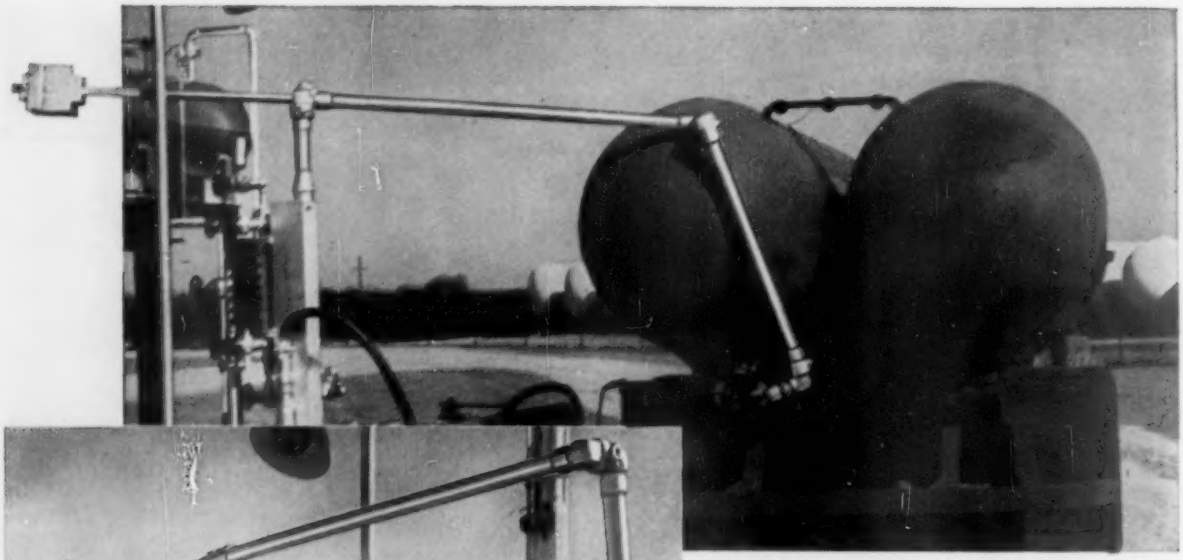
In the oil field, as elsewhere, Continental Red Seal power owes its fine reputation to the fact that every model is truly specialized—engineered with the needs of a specific application in mind. It delivers extra satisfaction for the simple reason that it's built to do one job supremely well. You'll find one or more models matching the exact requirements of just about every oil field job—in producing, distribution, or processing—and they're available for operation on all standard fuels.

RED SEAL ENGINES ARE BACKED BY PARTS AND SERVICE EVERYWHERE

Continental Motors Corporation

MUSKEGON • MICHIGAN

6 EAST 45TH STREET, NEW YORK 17, NEW YORK • 6218 CEDAR SPRINGS ROAD, DALLAS 9, TEXAS • 3817 SOUTH SANTA FE AVENUE, LOS ANGELES 58, CALIFORNIA • 910 SOUTH BOSTON STREET, ROOM 1008, TULSA, OKLAHOMA • 1252 OAKLEIGH DRIVE, EAST POINT (ATLANTA) GEORGIA



The truck loading rack illustrated here is made up of one 2", Style 50, one Style 40, one Style 50x5 high pressure steel Chiksan swivel joints, and one 1" Style 20 high pressure steel joint.

This truck loading rack in an Oklahoma gas company plant is manifolded so it can either load highly volatile Butane or Propane with complete flexibility and safety.

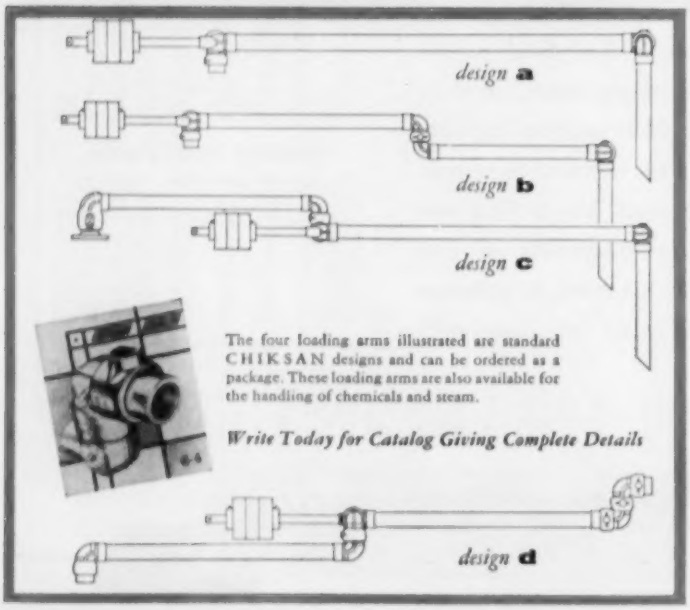
CHIKSAN adds Safety and Speed to Truck or Tank Car Loading of Gas or Chemicals

CHIKSAN provides the necessary liquid-tight, gas-tight connections, the characteristic flexibility of motion to keep volatile Butane and Propane or chemicals flowing swiftly with safety, economy and convenience.

Loading and unloading lines made up with dependable CHIKSAN ball-bearing swivel joints provide a wide margin of safety by using the same materials used throughout the pipe lines.

Any required degree of flexibility is provided, simply by arranging CHIKSAN ball-bearing swivel joints in proper sequence. Total length of any arm is governed by the required length of pipe sections between swivels. Whether it be a standard design loading arm or a special design for a specific problem, write CHIKSAN today, the nature of your requirements.

Write to Dept. OGJ-5 for Catalog giving complete detailed information.



The four loading arms illustrated are standard CHIKSAN designs and can be ordered as a package. These loading arms are also available for the handling of chemicals and steam.

Write Today for Catalog Giving Complete Details

The Flow of Enterprize Relies on

CHIKSAN

Ball-Bearing Swivel Joints

CHIKSAN COMPANY • BREA, CALIFORNIA • Chicago 3, Illinois • Newark 2, New Jersey

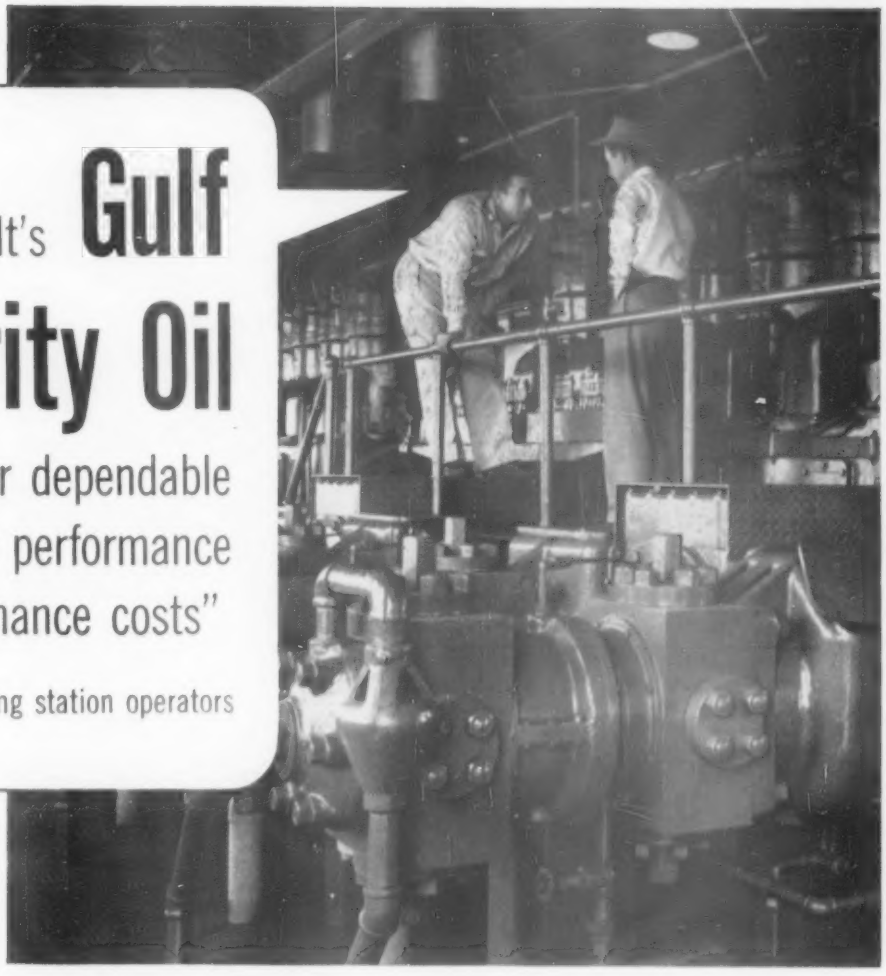
Well Equipment Mfg. Corp. (Division), Houston 1, Texas • Subsidiaries: Chiksan Export Co., Brea, Calif.; Newark 2, N. J. • Chiksan of Canada Ltd., Edmonton, Alta.

"It's **Gulf**

Security Oil

for dependable
gas compressor performance
and low maintenance costs"

say pumping station operators



Smooth, continuous operation is a must for these units in service at a South Texas gas compressor plant. They are responsible for the steady flow of essential natural gas through pipe lines to homes and industries as far north as Detroit and New York. Gulf Security Oil provides the sure, effective protection needed for cylinders and bearings in both engines and compressors.

You can depend on Gulf Security Oil to provide the proper lubrication that is so important to vital compressor units if operating troubles are to be prevented and maintenance costs kept low.

Gulf Security Oil has a record of outstanding performance in scores of gas transmission plants. After years of operation with this quality oil, the cylinders and piston rings of both the compressors and power assemblies show negligible wear. And few carbon deposits have formed on power cylinder ports and pistons.

If you are installing new compressor units, or feel that you're not getting the most effective lubrication possible for your present units, it will certainly pay you to try Gulf Security Oil. Contact your nearest Gulf Office and have a Gulf Sales Engineer call.

Gulf Oil Corporation • Gulf Refining Company
1822 GULF BUILDING, PITTSBURGH 30, PENNSYLVANIA

GULF

The finest petroleum products for your every need

You've heard it before—
You'll be hearing it more..
Mack
Mack
MENU

Mack's got it!

You'll find a wide and growing agreement among truck users these days. And they're putting it into the strongest words possible . . . ***Mack's Got It!***

It takes a lot of doing to deserve such all-out praise. How it all happened is quite a story. But you can get the gist in one simple statement of fact:

Mack is the only manufacturer to provide a completely new line of heavy-duty trucks since World War II . . . trued to the special requirements of modern business and industry.

Completely *new* means just what it says. New concepts. New designs. New engineering. New processes and metallurgy. Everything that contributes to greater operating economy, better performance, more profitable payloads, and assured safety. No effort or expense has been spared to realize these benefits . . . all with traditional Mack strength and dependability.

Look over these major achievements:

The most economical truck engine on the road today, the Mack-built Thermodyne® Diesel delivers more miles per gallon than any other engine handling like loads. It's a big reason why more Mack diesel trucks are bought each year than any other make.

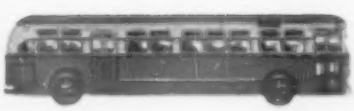
Maximum payload capacity for trucks and tractors through chassis design which combines greatest compactness with maximum accessibility of components and light weight.

Trucks that won't bog down under the most adverse conditions of mud, gravel or sand . . . because of traction supplied by famous Mack-built four-wheel-drive rear axle assembly combined with exclusive Mack Power Divider.

Newest Cab-Over-Engine design, either tilt-type or the revolutionary new raise-type Verti-Lift Cab, the ultimate in basic "cab-over" design.

When you get all the facts, we think you'll see that you can't afford *not* to own a Mack . . . and you'll agree "***Mack's Got It!***"

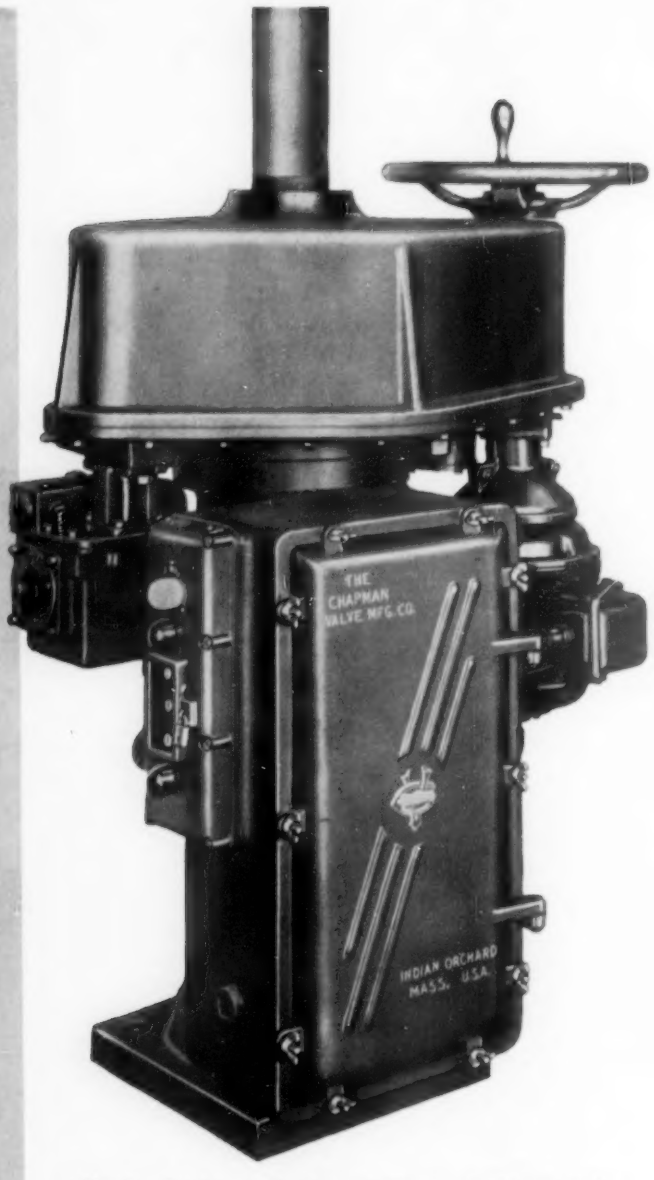
Mack TRUCKS



Mack Buses and Fire Apparatus have also been advance-engineered to best serve their important fields. *All along the line, Mack is really going places!*

Fewer Parts Mean Greater Dependability

Floorstand Motor Unit . . . control panel, motor, limit switch and push button station.



Simple, durable mechanism of Chapman's Motor Unit. Handwheel remains stationary during motor operation.

IN CHAPMAN MOTOR UNITS

Chapman's simple and rugged Motor Unit gives accurate, trouble-free control of large valves and sluice gates. It has approximately *half as many parts* as any other unit. Its simplified design, low speed motors and low-ratio, stubtooth gears combine to give positive operation without drift, in *any* position and under all conditions.

Installation is fast and simple. The floorstand unit comes completely wired, ready to connect to leads. Limit switch has micrometer adjustment for exact pre-setting for seating tightness. Motor Units operate smoothly under the most adverse conditions. All units are weather-proof and steam-tight. Write today for *new* Catalog 51.

The Chapman Valve Manufacturing Co.

INDIAN ORCHARD, MASSACHUSETTS

SINCLAIR OIL CORPORATION

says

OK

in print

Thriftiest Boiler
in the business
ANOTHER SINCLAIR FIRST!
SINCLAIR OIL CORPORATION • 600 FIFTH AVENUE • NEW YORK 20, N. Y.
SINCLAIR
A Great Name in Oil

Sinclair Oil Corporation pioneered a new boiler to secure greater efficiency in refinery operation. This advertisement from the Oct. 16, 1954 Business Week emphasizes the results obtained with this unit.

This B&W Carbon Monoxide Boiler, installed to absorb the heat from the exhaust gas stream of Sinclair's new Houston fluid cracking unit, was the first of its kind to go into refinery service. Here are the operating results:

Gas weight to boiler—lb per hr	650,000
Gas temperature to boiler—	990
Per cent CO in gas stream to boiler—, % by volume	4.8
Steam from sensible heat and combustible in cracking unit exhaust gas—lb per hr	220,000
Total steam capacity, boiler and economizer—lb per hr	330,000
Btu saved from cracking unit gas stream—Btu per hour	218,000,000

The Babcock & Wilcox Company, Boiler Division
161 East 42nd Street, New York 17, N. Y.

BABCOCK & WILCOX

BOILER DIVISION

G-700

Examine this new OIC valve model for 5 minutes. See how its unusual design features can lower your valve and maintenance costs.

It's an exact 2" model of the newly designed OIC cast steel, lubricated plug valve. On test, its 6" big brother endured 3000 full openings and closings at 425 p.s.i. pressure on solvent. It remained pressure tight, operable at low torque, and showed no sign of galling or seizing. You'll understand why, when you study the model.

See how its exclusive gland liner retains plug adjustment longer. Examine the valve's multiple seals. Operate it. Look at the design of its 4 plug grooves and see how more efficient lubricant distribution preserves the valve's primary seal. Its many life-extending features are all in the model.

Every OIC salesman has one. When he calls, ask to see it. Analyze its values. You'll be handling a model of the most modern lubricated plug valve known.

For complete advance information and specifications on the OIC lubricated plug valve line, write for Bulletin 1003.

OIC
FOUNDED 1883

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

VALVES | FORGED & CAST STEEL, LUBRICATED PLUG, BRONZE & IRON VALVES

in the manufacture of A. O. Smith Line Pipe...

Every fifth man on the production line is a

Quality control

SPECIALIST!

QUALITY CONTROL works full-time in the manufacture of line pipe at A. O. Smith. It's everyone's detail on his own particular job. But in addition, one out of every five employees is a *specialist in quality control.* These inspectors closely and constantly check each operation during production. Their department, independently responsible to management, has full authority to stop any operation for correction when necessary.

QUALITY CONTROL begins outside of A. O. Smith. At the steel mill, A. O. Smith technicians cooperate with mill inspection and control. QUALITY CONTROL continues in A. O. Smith Metallurgical and Testing Laboratories. Finally, from the pickled plate to the shipping platform, it scrutinizes and checks every operation in the manufacture of the A. O. Smith pipe.

QUALITY CONTROL that never leaves the production line is yours at no extra cost when you choose A. O. Smith line pipe. Remember — QUALITY CONTROL is as important to A. O. Smith as it is to the customer. Through it we seek to better serve our customers.

Through research ... a better way

A.O.Smith

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FISHER *Rugged*

TYPE 630

FOR INLET PRESSURES UP TO 1500 psi

Fisher's famous Big Joe Type 630 is the best regulator for rugged high pressure jobs. It's ideal for Farm Taps, Small Border Stations, and Industrial Installations. For completely dependable service, there is no regulator like the Big Joe — it's backed by thousands upon thousands of installations along the major pipe lines of this country.

TYPE 620

MAXIMUM OPERATING INLET PRESSURES UP TO 750 psi

(Maximum allowable inlet pressure 1000 psi)

The Fisher Type 620 pounds to pounds regulator is especially designed for *economical* first stage reduction of gas pressure for farm taps on high pressure transmission systems.

Also suitable for industrial gas applications, as a Propane tank reducing valve, and for numerous other installations where good regulation is required on gas service.

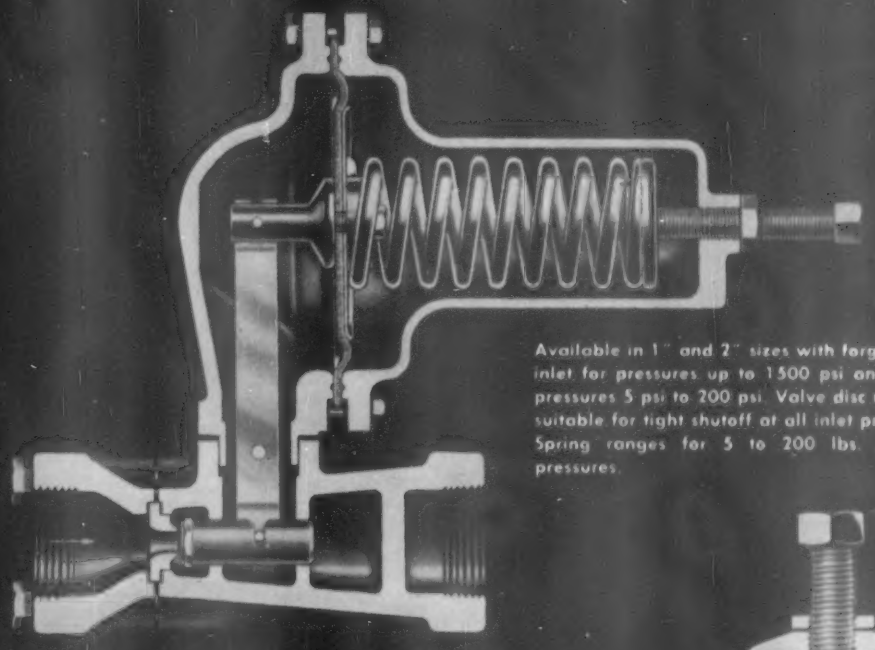
Write for New Fisher Bulletin P-11.

FISHER GOVERNOR COMPANY

LEADS THE INDUSTRY IN RESEARCH FOR

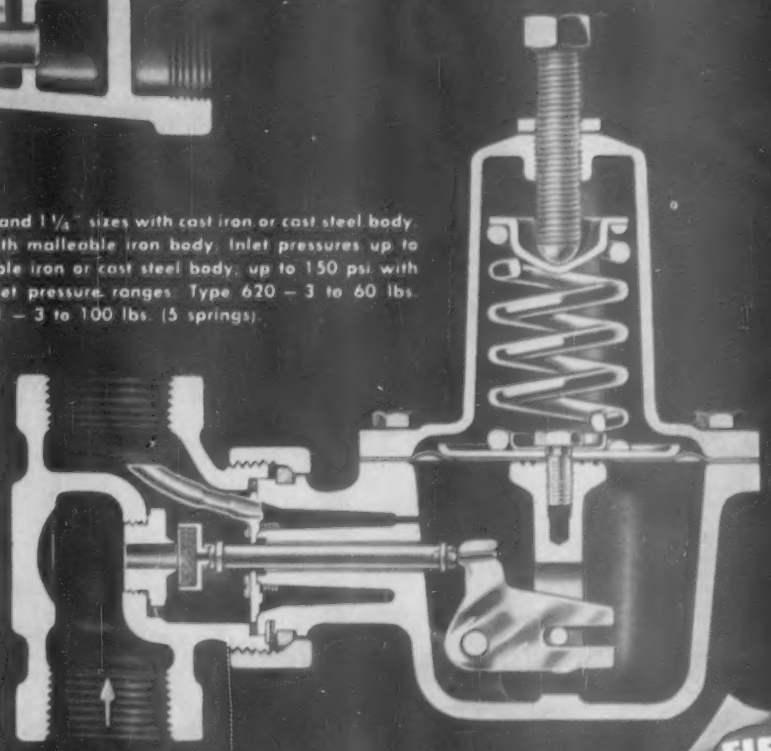
Regulators for High Pressure Jobs

...for POUNDS to POUNDS SERVICE



Available in 1" and 2" sizes with forged steel inlet for pressures up to 1500 psi and outlet pressures 5 psi to 200 psi. Valve disc material suitable for tight shutoff at all inlet pressures. Spring ranges for 5 to 200 lbs. reduced pressures.

Available in ¾", 1" and 1¼" sizes with cast iron or cast steel body. ¾" and 1" sizes with malleable iron body. Inlet pressures up to 750 psi with malleable iron or cast steel body, up to 150 psi with cast iron body. Outlet pressure ranges: Type 620 — 3 to 60 lbs. (4 springs). Type 621 — 3 to 100 lbs. (5 springs).



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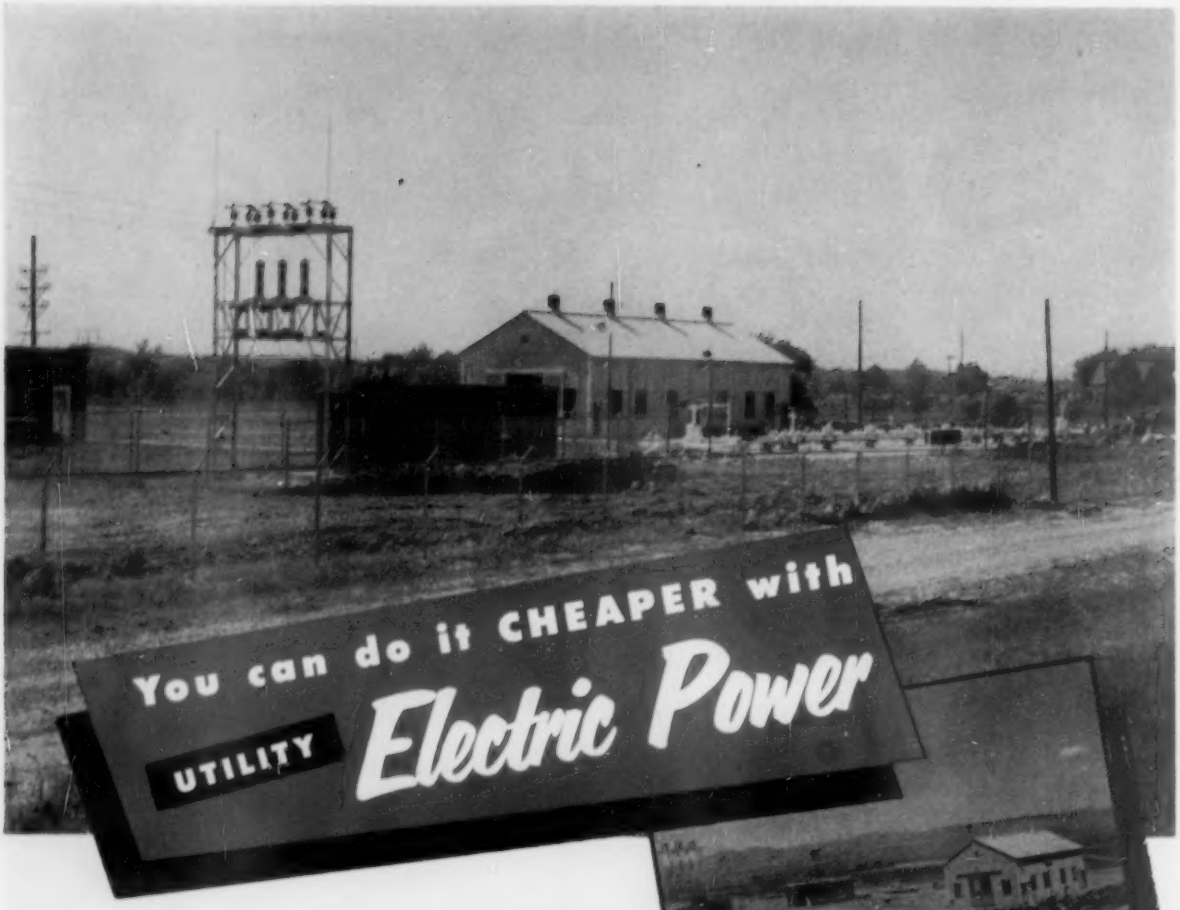
BETTER GAS PRESSURE CONTROL

FISHER

Our 75th ANNIVERSARY



Two More Pipeline Stations
NOW USING LOW COST
UTILITY ELECTRIC POWER!

Why? Because Utility Electric Power cuts down installation, operating, maintenance and labor costs. Convenient? You bet! With Utility Electric Power, you have constant, dependable service, remote automatic controls, and a smoother, more satisfactory, trouble-free operation.

Now's the time to check into Utility Electric Power for Your Power Needs.

CALL YOUR LOCAL ELECTRIC UTILITY COMPANY FOR POWER FACTS

Petroleum Electric Power Association P. O. BOX 2771, DALLAS, TEXAS

ORGANIZED IN THE INTEREST OF GREATER SERVICE TO THE PETROLEUM INDUSTRY

Whether You Pig or Blowdown—

W-K-M Through-Conduit Valves are your safest investment

Though it may be only once, sooner or later you'll want to run a scraper through your line. And if you have to burn out valves with obstructed bores, then and there you've paid more than the difference between W-K-M Through-Conduit Valves and less efficient valves. So you are way ahead if you install W-K-M Through-Conduit Valves today. Not only do you avoid an emergency shut down, but you get performance unequalled by any other valve at any price. There are many more reasons why W-K-M Through-Conduit Valves should be on your mainline. Call your nearest W-K-M sales engineer and ask him to show you the miniature working model which tells all.

W-K-M Valves

W-K-M Manufacturing Company, Inc.

A subsidiary of ACF Industries Incorporated

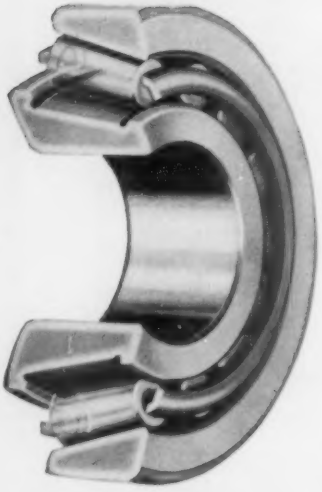
P. O. Box 2117, Houston 1, Texas Los Angeles, California

Export Office: 45 Rockefeller Plaza, New York, N. Y.

THROUGH-CONDUIT VALVES • VENTURI VALVES • MODEL Q VALVES

WHATEVER YOUR ROLLER BEARING APPLICATION

specify BOWER!



Earthmovers, jet turbine engines, rolling mill equipment, truck axles—you name it! Bower builds a complete line of tapered, straight and journal roller bearings including a size and type to fit *your* product. What's more, these dependable bearings have *proved* themselves in virtually every conceivable type of application. Their built-in quality, skillful engineering and advanced design features provide such important bearing advantages as reduced wear, longer life and lower maintenance requirements. Let a Bower engineer give you full details on the complete Bower line.

BOWER ROLLER BEARING COMPANY
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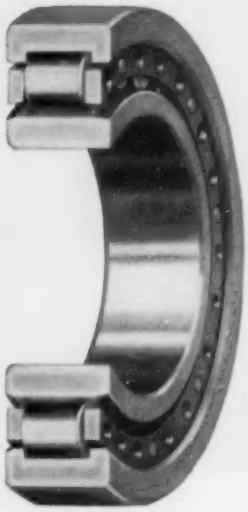
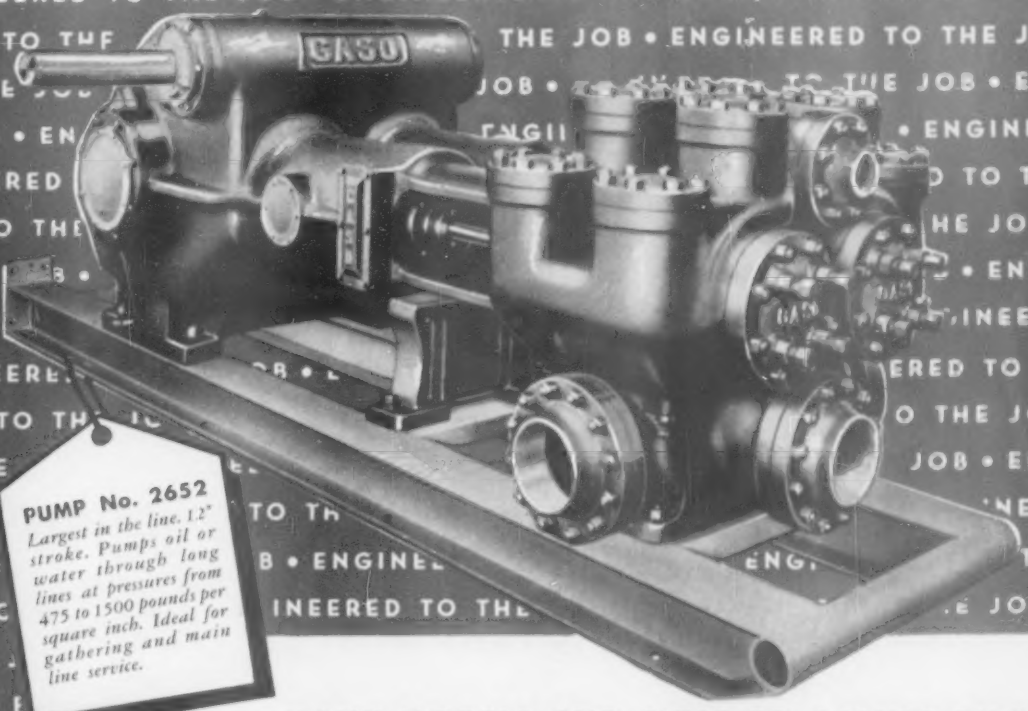


BOWER TAPERED ROLLER BEARINGS INCORPORATE ADVANCED SPHER-O-HONED DESIGN! Spherically generated roll heads and higher flange with larger, two-zone contact area reduce wear, improve roller alignment and virtually eliminate "end play." This helps hold adjustment and pre-load longer and better. Larger oil groove provides positive lubrication.

BOWER STRAIGHT ROLLER BEARINGS ARE BUILT TO CARRY MAXIMUM LOADS! Integral two-lip race increases rigidity—keeps rollers in proper alignment at all times. Steel cage allows free movement of rollers between races during normal operation. High-grade alloy-steel rollers and races are precision-ground for quieter, smoother operation.

A COMPLETE LINE OF TAPERED, STRAIGHT AND JOURNAL ROLLER BEARINGS
for every field of transportation and industry

BOWER
ROLLER BEARINGS
SPHER-O-HONED



PUMP No. 2652
Largest in the line. 12" stroke. Pumps oil or water through long lines at pressures from 475 to 1500 pounds per square inch. Ideal for gathering and main line service.

MANY MODELS AND SIZES TO ASSURE PUMPS

ENGINEERED TO THE JOB

It's a fact worth repeating: *Gaso offers the oil industry's most COMPLETE line of portable pumps,* developed through more than a third of a century to meet every need. Whatever your requirements, you will find in the Gaso line a size and model engineered to the job . . . with inbuilt capacity to deliver maximum performance with minimum maintenance for unbelievably long periods of time. Write for latest catalog.

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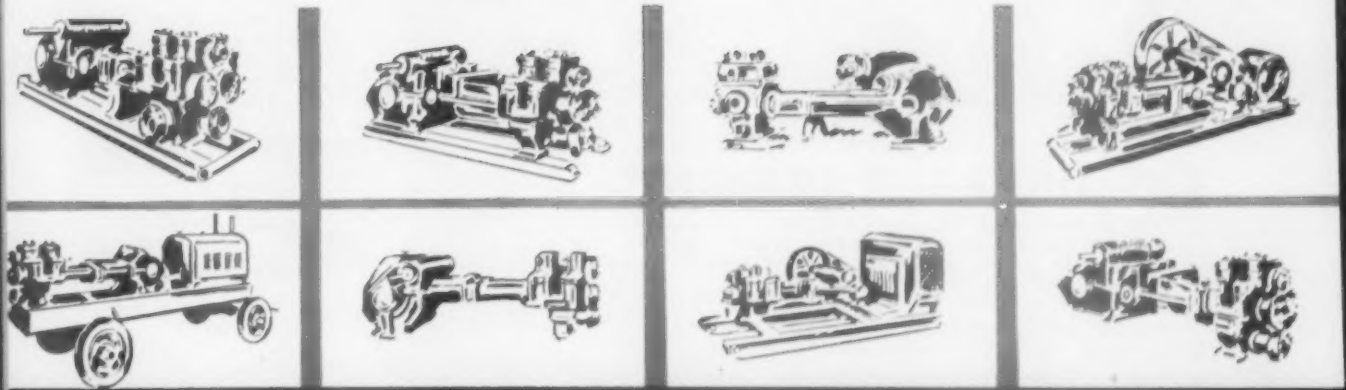
GASO PUMPS
for every oil industry need



GASO - THE COMPLETE LINE OF PORTABLE PUMPING UNITS

PIPELINE CONTROL and COMMUNICATIONS

with MICROWAVE by *Collins*

Collins Microwave provides extremely reliable channels for multi-purpose communication and control of pipelines and other wide-spread facilities. Collins broadband microwave and mechanically filtered single sideband channels are designed for reliable performance, high channel capacity and ease of maintenance. Building block construction plus single sideband modems allow flexibility in meeting today's needs with ready expansion as your requirements increase. Channels may be used for a large number of private telephone circuits as well as remote VHF station operation, supervisory control, system telemetering, automatic load control, centralized office accounting, facsimile and teletype.

COLLINS quality plus these features

- LONG-LIFE REFLEX KLYSTRON provides reliable, low power, broadband microwave transmitter.
- HIGH GAIN ANTENNAS and reflectors provide reliable propagation links at 6700 mc.
- NON-CRITICAL IF AMPLIFIER employs fixed-tuned filters to achieve 14 mc passband.
- TUBELESS POWER SUPPLIES employ magnetic amplifiers for regulation.
- RELIABLE TUBES (ARINC-approved types). Only 4 tube types, including klystron.
- FREQUENCY DIVISION MULTIPLEX provides flexible channeling without complicated or critical circuitry.
- MECHANICAL FILTERS provide reliable permanently-tuned channel selectivity with almost rectangular passband.
- BILATERAL SINGLE SIDEBAND SUPPRESSED CARRIER permits high channel loading with two channels per subcarrier.
- OPTIONAL AUTOMATIC SWITCHOVER to standby RF and standby common multiplex.
- MAINTENANCE FEATURES include built-in test facilities, articulated hinges, grasshopper fuses, fault alarm, and service channel.

Write for descriptive literature

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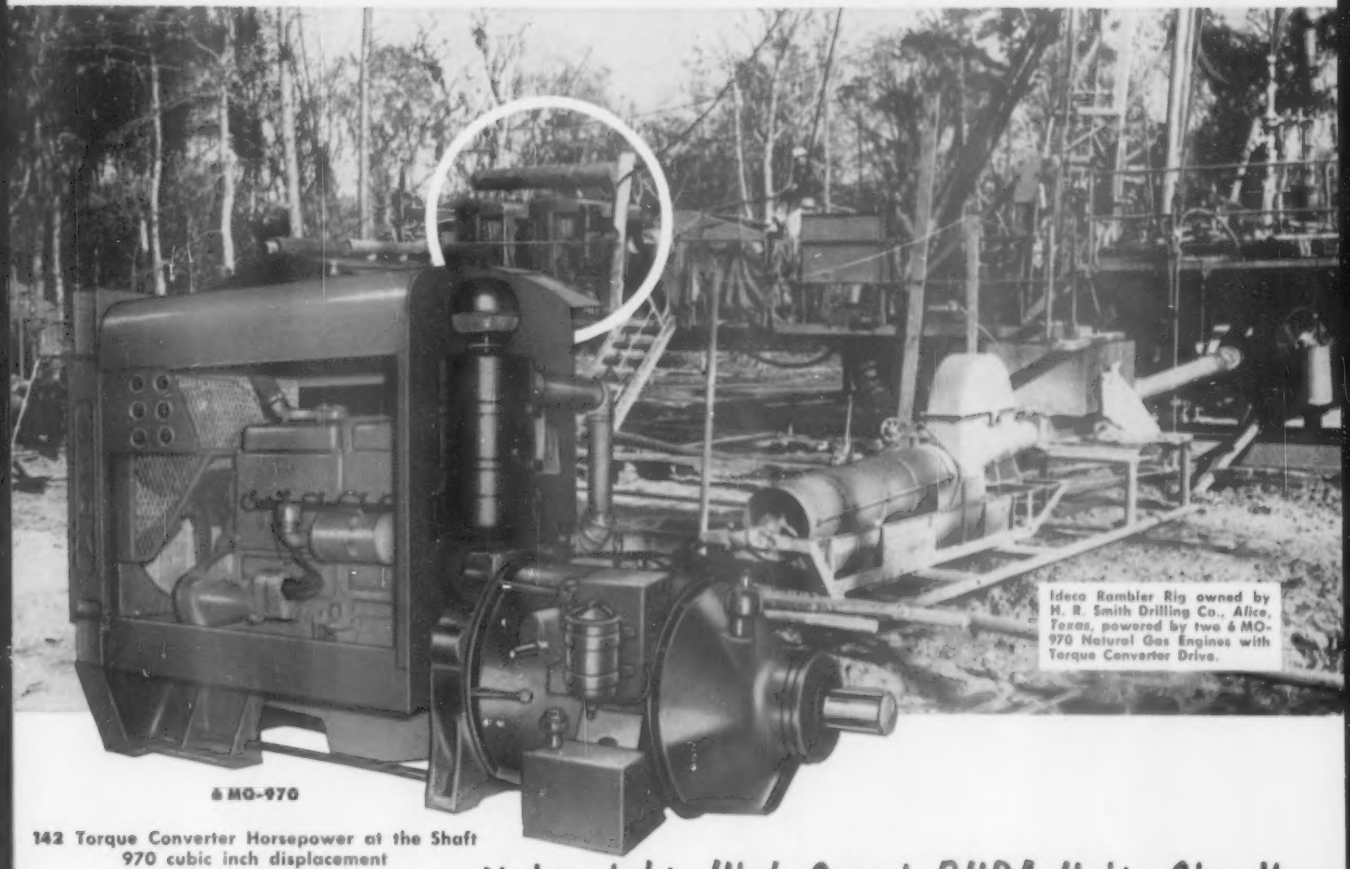
COLLINS

BIG Power In A Small Package!

That's The Buda Engine – TORQUE CONVERTER Unit Story



Ideco Rambler Rig owned by H. R. Smith Drilling Co., Alice, Texas, powered by two 6 MO-970 Natural Gas Engines with Torque Converter Drive.

6 MO-970

142 Torque Converter Horsepower at the Shaft
970 cubic inch displacement
Natural Gas — Butane

Lightweight, High Speed BUDA Units Give You

POWER and PORTABILITY

For FASTER HOLE and MORE HOLE PER RIG

Pound-for-pound . . . dollar-for-dollar, you get more useable horsepower and torque from the new Buda Diesel, natural gas, or butane powered Torque Converter Units, than any other kind of engine power.

Designed and built for drilling service, Buda Torque Converter Units give you maximum output horsepower . . . a wide range of torque for greater flexibility, less gear shifting, smoother operation, fewer mud pump liner changes, and many other advantages, all adding up to faster drilling and lower all around costs.

Sales arguments, advertisements and power curves tell only part of the Buda Torque Converter Unit story. Their performance on a rig really sells them. **Ask an owner or operator** how they're doing and you'll get first hand, a success story that's the talk of the industry.

Before you buy or specify any new power, get the facts on Buda Torque Converter Units from your nearby Buda Oilfield Distributor. Write for new Bulletin #1742.

BO-30

BUDA DIVISION • HARVEY, ILLINOIS
ALLIS-CHALMERS MANUFACTURING COMPANY

BUDA

OILFIELD SERVICE EVERYWHERE

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Midway Tool Company
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Mississippi
W. L. Somner Co., Inc.
Brookhaven and Tinsley

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Arrow Engine Sales & Service
St. Louis

New Mexico
Industrial Supply Co.
Albuquerque

New York (Export)
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Canada
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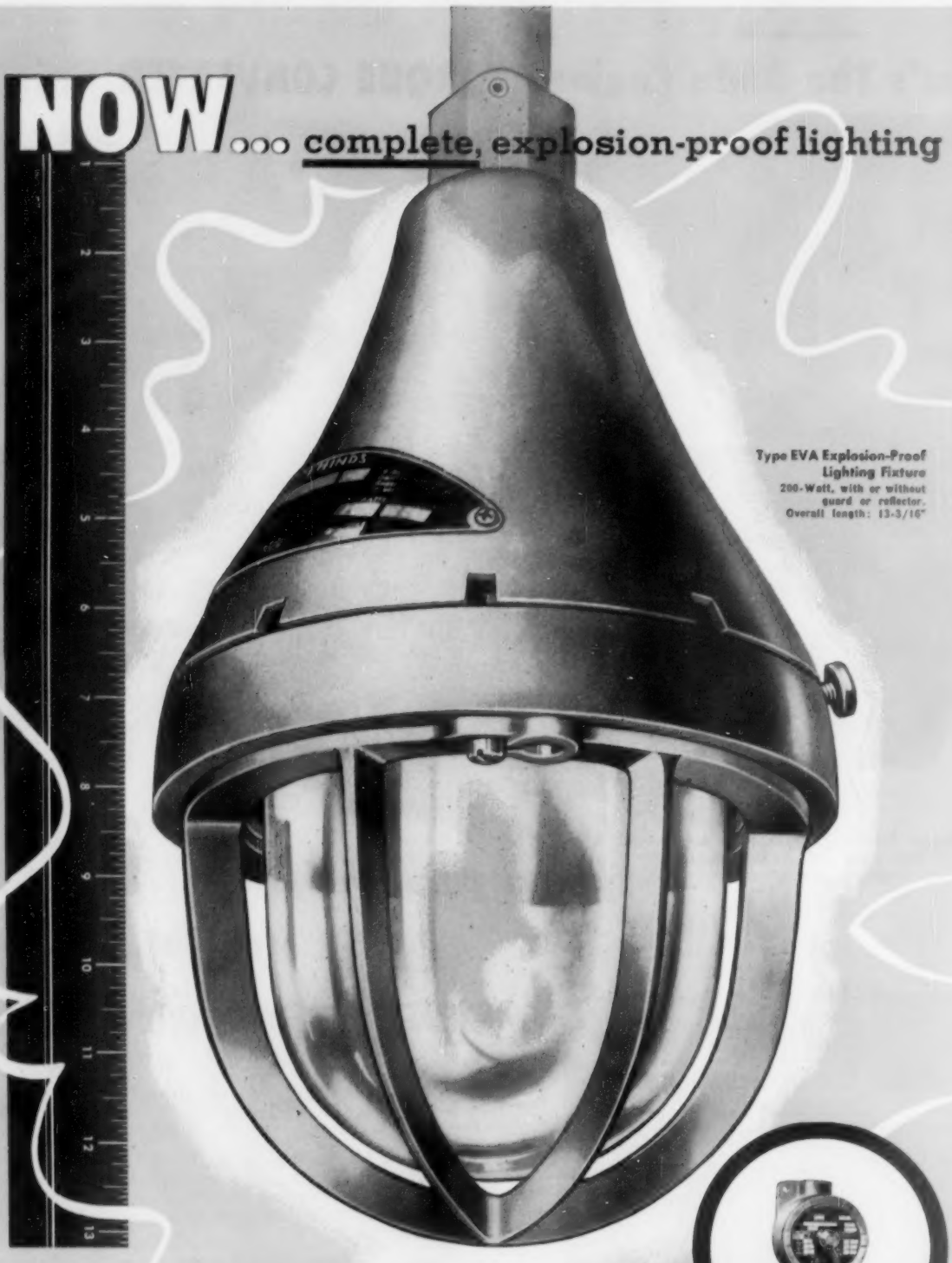
Edmonton and Calgary

NOW ... complete, explosion-proof lighting



Type EVA Explosion-Proof Lighting Fixture
200-Watt, with or without guard or reflector. Overall length: 13-3/16"

Type FSPC Explosion-Proof Tumbler Switch Conduletes
in 1, 2, 3-pole; 3 and 4-way; DP DT (no "off") styles.

NO AIR PRESSURE NEEDED! Since Type EVA contains the explosion rather than preventing it, no "pumping up" is required. Nor is there any pressure switch to fail and possibly create a hazardous condition. Also, fixture need not be removed from the hazardous area to re-lamp. Merely switch off the circuit – unscrew globe holder – replace lamp. Less maintenance, *easier* maintenance and much lower initial cost are plus features of this new explosion-proof Crouse-Hinds Lighting Fixture.

installations for acetylene and hydrogen areas!

CROUSE-HINDS

CONDULETS®

UL-Approved for Class 1, Groups A & B Locations

From switch to lighting fixture, Crouse-Hinds' is the first *complete* lighting system designed and UL-approved for Class 1, Groups A & B, as well as C & D hazardous locations.

These explosion-proof fixtures and Condulets are entirely new — provide greater installation flexibility. Fixtures may be re-lamped — *even in the presence of combustible gases* — since gas-tightness is *not* a requirement for their safe performance. And they *are* safe . . . their heavier, more shock-resistant construction withstands the pressure of internal explosions without rupturing . . . their flame-tight joints prevent the escape of flames of flammable atmospheres.

✳ Whether you're installing a complete explosion-proof lighting system — or merely converting a few of your Group C or D fixtures to these safer Group A's — your Crouse-Hinds Distributor can be a definite help. See him. Or write us.

A NATIONWIDE DISTRIBUTION exclusively through ELECTRICAL DISTRIBUTORS

CROUSE-HINDS COMPANY

SYRACUSE 1, N. Y.

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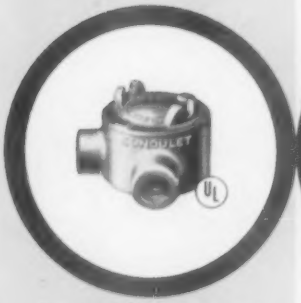
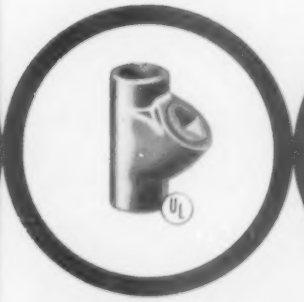
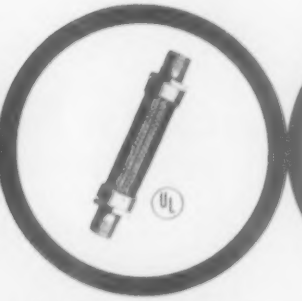
Crouse-Hinds Company of Canada, Ltd. — Toronto, Ont.



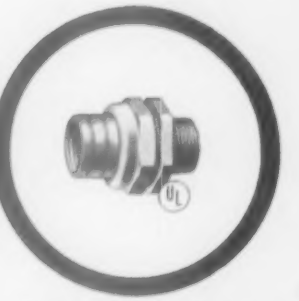
Type EAB Explosion-Proof Junction Condulets in ½", ¾" and 1" hub sizes—through feed, L, T and X hub arrangements.



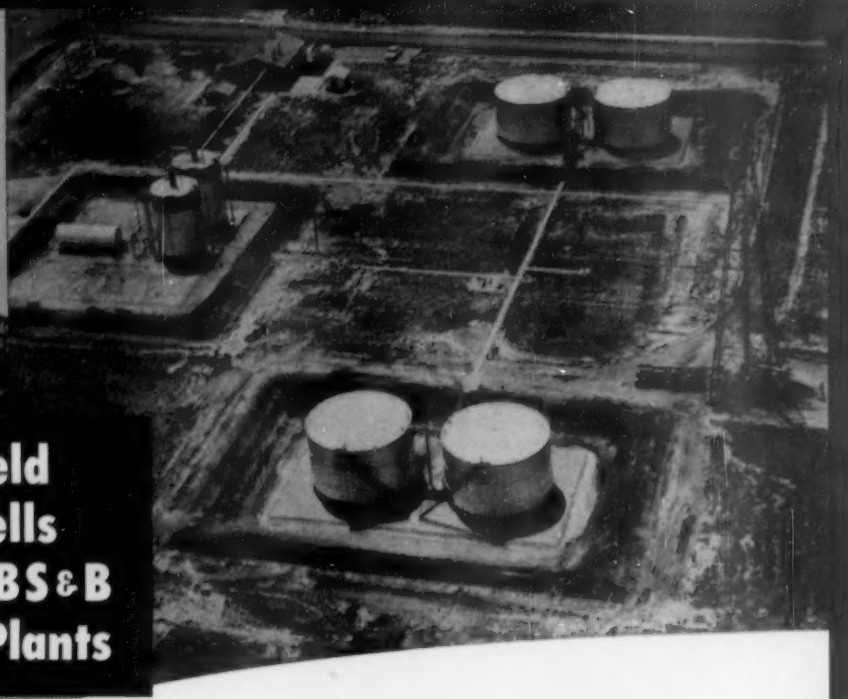
Type EYS Explosion-Proof Sealing Condulets in ½", ¾" and 1" hub sizes.



Type EC Explosion-Proof Flexible Couplings and fixture supports in ½" and ¾" sizes.



Types UNY, UNL, UNF Explosion-Proof Condulet Unions female and male styles in ½", ¾" and 1" sizes.



Entire 8,800-Acre Field Containing 2,300 Wells Now Served By Two BS&B Waterflood Treating Plants

An Actual Case History From Our Files

Two recently completed BS&B Waterflood Treating Plants are now serving the operators* of the unitized Lake Centralia-Salem Oil Field, approximately 6½ miles long and 2½ miles wide, in southern Illinois.

PROBLEM: At the time of unitization, this field contained more than 365 tank batteries servicing approximately 2,300 wells. Most of these tank batteries were 10 years old or more, and with gas depletion and the necessity for installing gathering lines for waterflooding, a unique treating problem was presented.

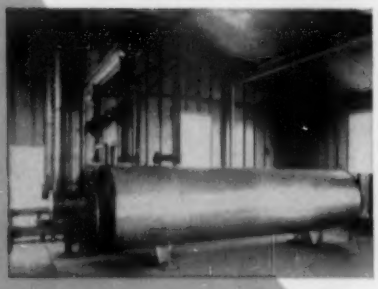
SOLUTION: It was decided to consolidate the entire production through two large treating plants, each of which was to have an initial design capacity of 10,000 BOPD and 35,000 BWPD, with an ultimate capacity of 30,000 BOPD and 115,000 BWPD. Each plant was to consist of the following basic items of equipment:

1 BS&B 10′ x 28′ Freewater Knockout
2 BS&B 70LSH Steam Generators
2 BS&B 30″ x 21′ x 6″ Heat Exchangers
2 BS&B 21′-6″ x 32′-2″ 2,000 Bbl. Settling Tanks
4 BS&B 38′-7⅝″ x 24′-1½″ 5,000 Bbl. Stock Tanks

Plants were to be so constructed that equipment could be added or removed without interrupting operations. Water of 1.05 specific gravity was to be removed from oil of approximately 37° API.

RESULT: Test results on these plants have been most satisfactory. Heat exchangers were transferring 2,000,000 BTU/Hr./heat exchanger under medium load with only one steam generator firing. Water carry over from the freewater knockout was less than 1%. The grind outs do not exceed .002 to .003%.

* Name supplied on request.

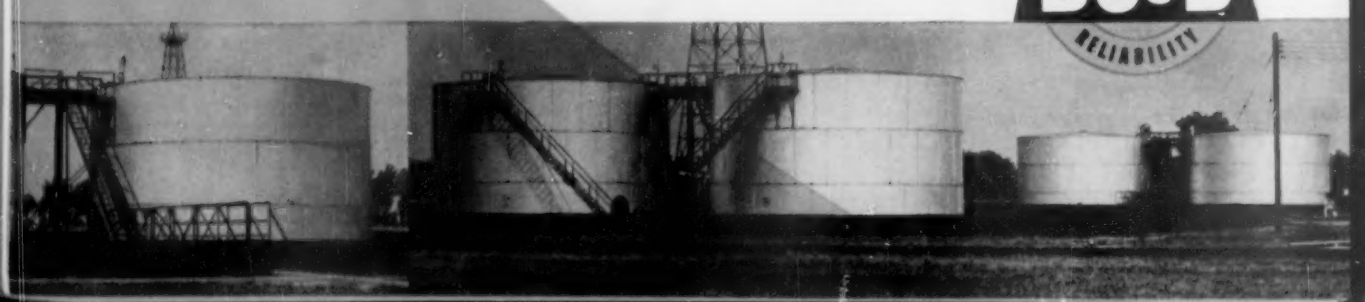


BLACK, SIVALLS & BRYSON, INC.

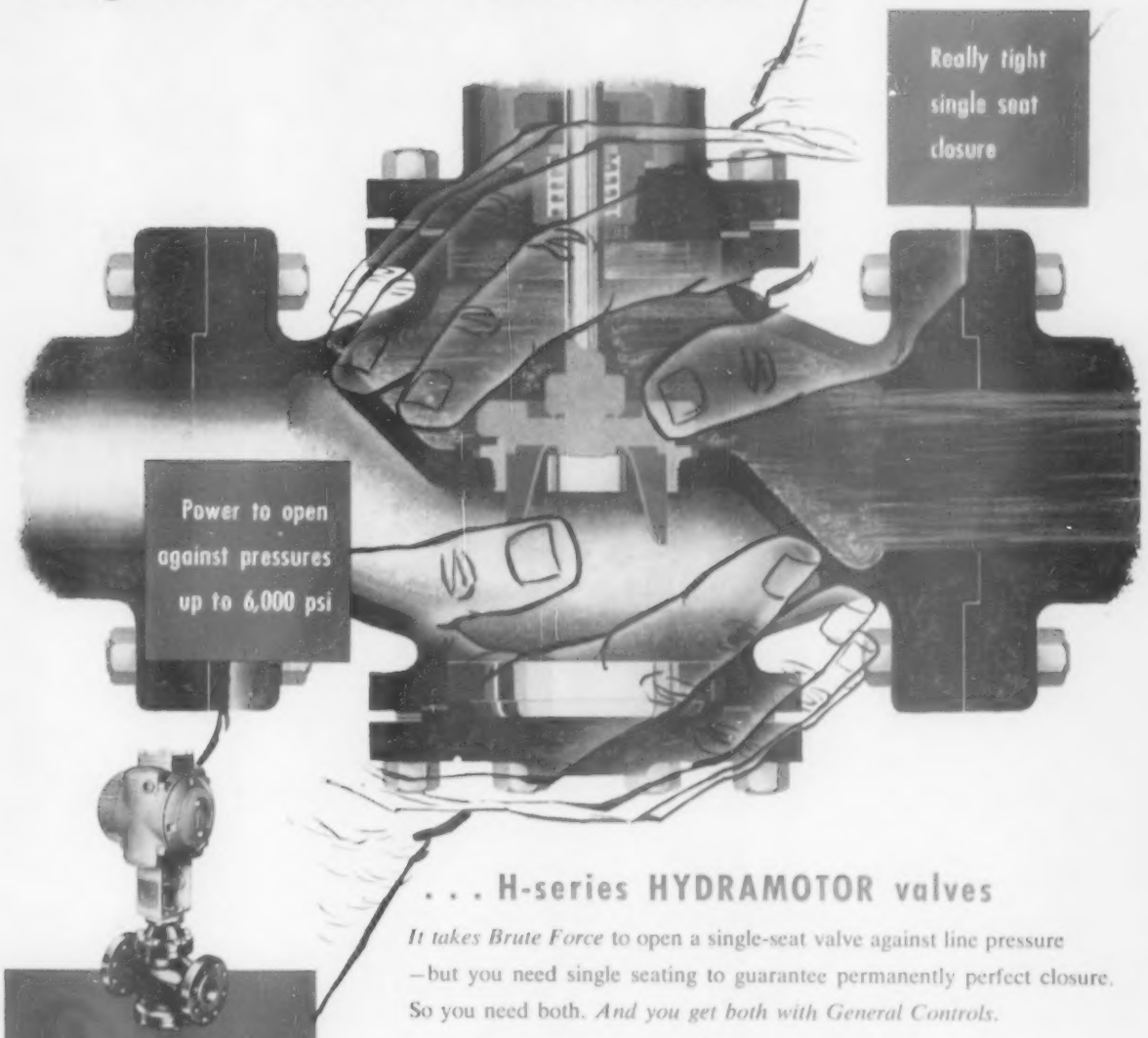
Oil & Gas Equipment Division, Dept. 1-A5

1708 West Main Street • Oklahoma City, Oklahoma

EFFICIENCY
OVER 60 YEARS
BS&B
RELIABILITY



You get both with General Controls



. . . H-series HYDRAMOTOR valves

It takes Brute Force to open a single-seat valve against line pressure—but you need single seating to guarantee permanently perfect closure. So you need both. *And you get both with General Controls.*

You get even more: No gear problems with its electro-hydraulic action . . . sealed unit safety for top efficiency in any weather . . . instant response to simple two-wire control, with three-wire available for remote positioning.

When you lay out cost-saving automatic transfer systems, count on General Controls to simplify your problems with dependability proved by over 15 years in the field—and a complete range of sizes, materials and speeds to meet the varied needs of the food, process, and oil industries.

General Controls *Hydramotor* VALVES

For more detailed information, send for HYDRAMOTOR CATALOG, 801 Allen Ave., Glendale 1, Calif.

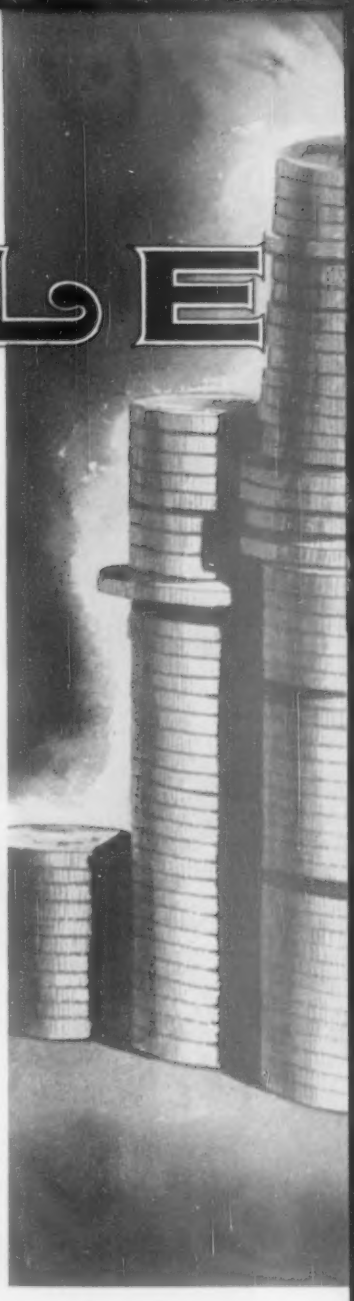
YEARS

GENERAL CONTROLS

PLANTS: GLENDALE, CAL. • BURBANK, CAL. • SKOKIE, ILL. • 40 BRANCH OFFICES SERVING THE NATION

MANUFACTURERS OF AUTOMATIC CONTROLS FOR THE HOME, INDUSTRY AND THE MILITARY

GAMBLE



THE GAMBLERS of the great gambling casinos of the world are pikers compared to these four players. They gamble against odds that make the odds of Reno, Las Vegas, and Monte Carlo pale into insignificance by comparison.

But no gamblers ever try harder to take the gamble out of their work than these four players. Their odds are the vagaries of nature. Their skill in meeting the odds depends on science, engineering, invention. P.E.S.A.'s nine thousand engineers and the engineers of their great customer, the oil-producing industry, work around the clock to reduce these odds.

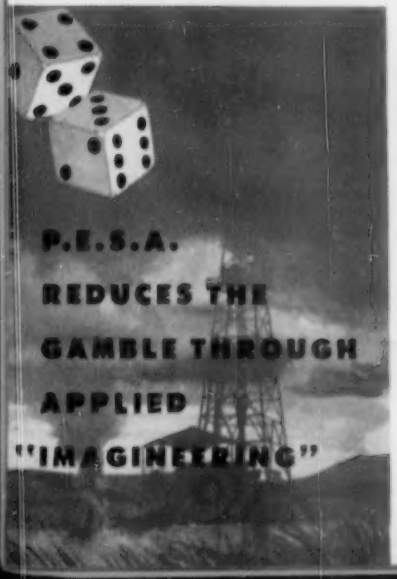
These four players are:

P.E.S.A. Manufacturers venturing their capital to make better tools and equipment to stand the extreme pressures, abrasive cutting, shock, and mounting temperatures necessary to keep the wells going to three-mile depth and beyond.

P.E.S.A. Supply Companies venturing their capital to assure oil operators getting ALL the equipment necessary for carrying on oil field operations *when* they want it and *where* they want it.

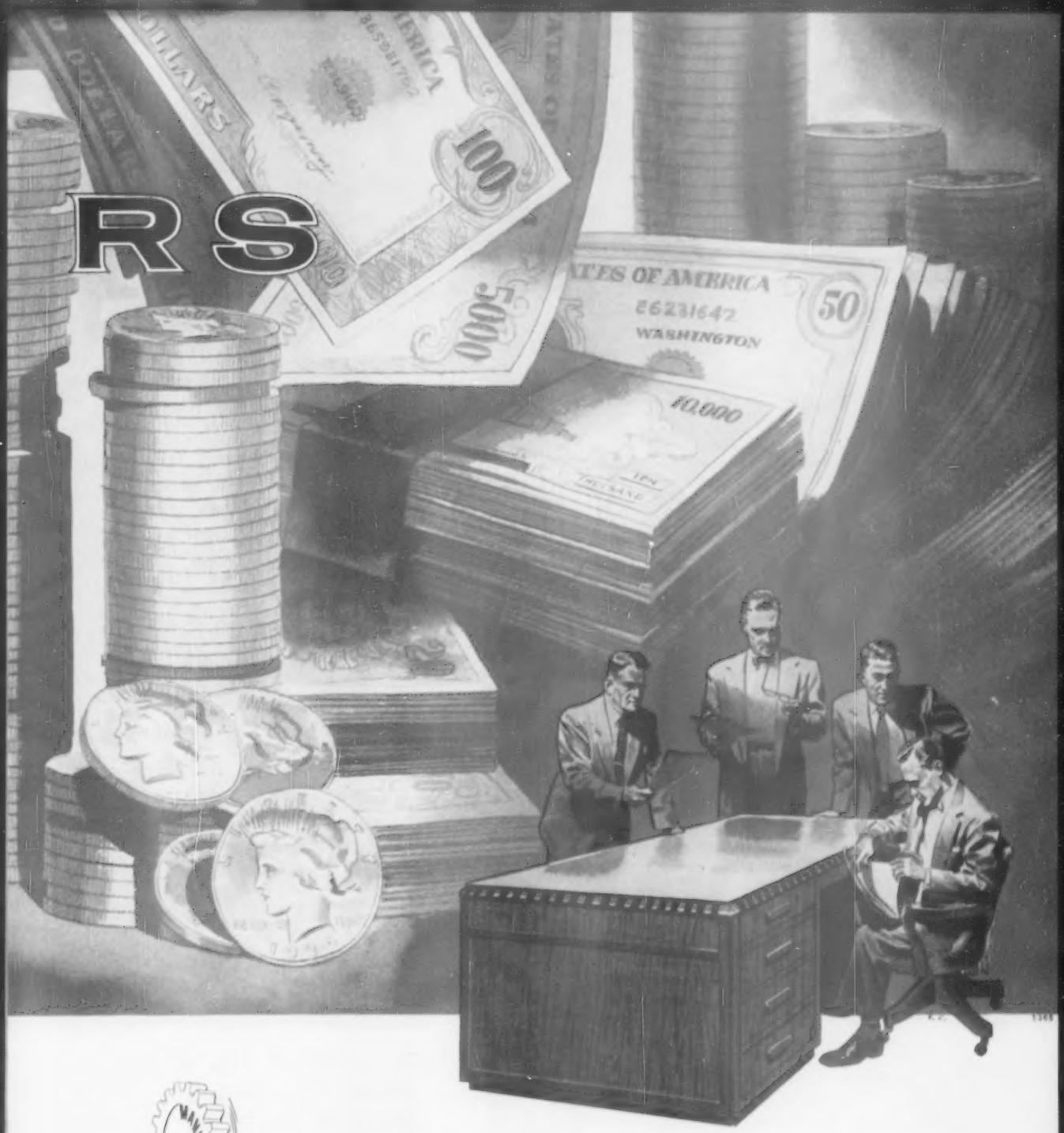
P.E.S.A. Service Companies venturing their capital in order to carry on expensive basic research necessary to solve the highly technical problems connected with much oil field service; in order to develop and construct the equipment necessary to adapt theory to practice; in order to provide the highly skilled scientists, engineers and technicians necessary to perform the services and to lend their know-how, integrity, and sincerity of purpose to help analyze well problems and recommend effective, economical solutions.

Oil Companies venturing their capital to obtain oil leases; to apply geology and geophysics to finding favorable formations; to spending great sums of money to find if oil-bearing formations exist, and then to provide the large amount of money necessary to bring the oil out of the ground and transport it to the refineries.



• • •

There are no greater gamblers than the intrepid, risk-taking pioneers who have developed the oil industry into one of the world's greatest and most important businesses. They take risks, but they are calculated risks based on all the scientific knowledge that brilliant men can bring to bear on problems connected with exploring and operating in the depths of the earth. The depletion allowance is recognition of this risk and is a necessary incentive. The aggressive venturism of hardy men also finds its reward in being able to operate under the American free-enterprise system. That's the secret of America's greatness.



MANUFACTURE
SUPPLY
SERVICE

P.E.S.A.*

* Petroleum Equipment Suppliers Association

Composed of: manufacturers whose plants make the finest precision equipment . . . *supply stores* who add two other ingredients of value — where you want it — when you want it . . . *service companies* who make available to their customers the practical results of the theoretical research of some of the most brilliant scientific and technical men in the world.

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PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION
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TO GET WHAT YOU WANT WHERE YOU WANT IT WHEN YOU NEED IT . . . AT REASONABLE COMPETITIVE PRICES

"Buy From Bovaird"

THE Bovaird SUPPLY COMPANY

GENERAL OFFICES
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84 YEARS OF PROGRESS WITH THE OIL INDUSTRY

NOW, FOR DEEP OR HIGH PRESSURE WELLS:

Oil and gas well tubing 50% stronger than the highest API grades!

TIMKEN® Seamless Steel Tubing for deep well applications is available with yield strengths up to 125,000 psi, suitable ductility, good corrosion resistance

TIMKEN® seamless steel tubing, capable of withstanding internal pressure up to 15,000 psi, and strong enough for the deepest wells contemplated today, is furnished by the Timken Company in a wide range of sizes and a variety of analyses. Some of the analyses are specially selected for corrosion resistance, all are ductile when properly heat-treated.

While the strongest grade in API Specifications —5A—only calls for 80,000 psi yield strength, Timken steel tubing can be furnished with a yield strength up to 125,000 psi.

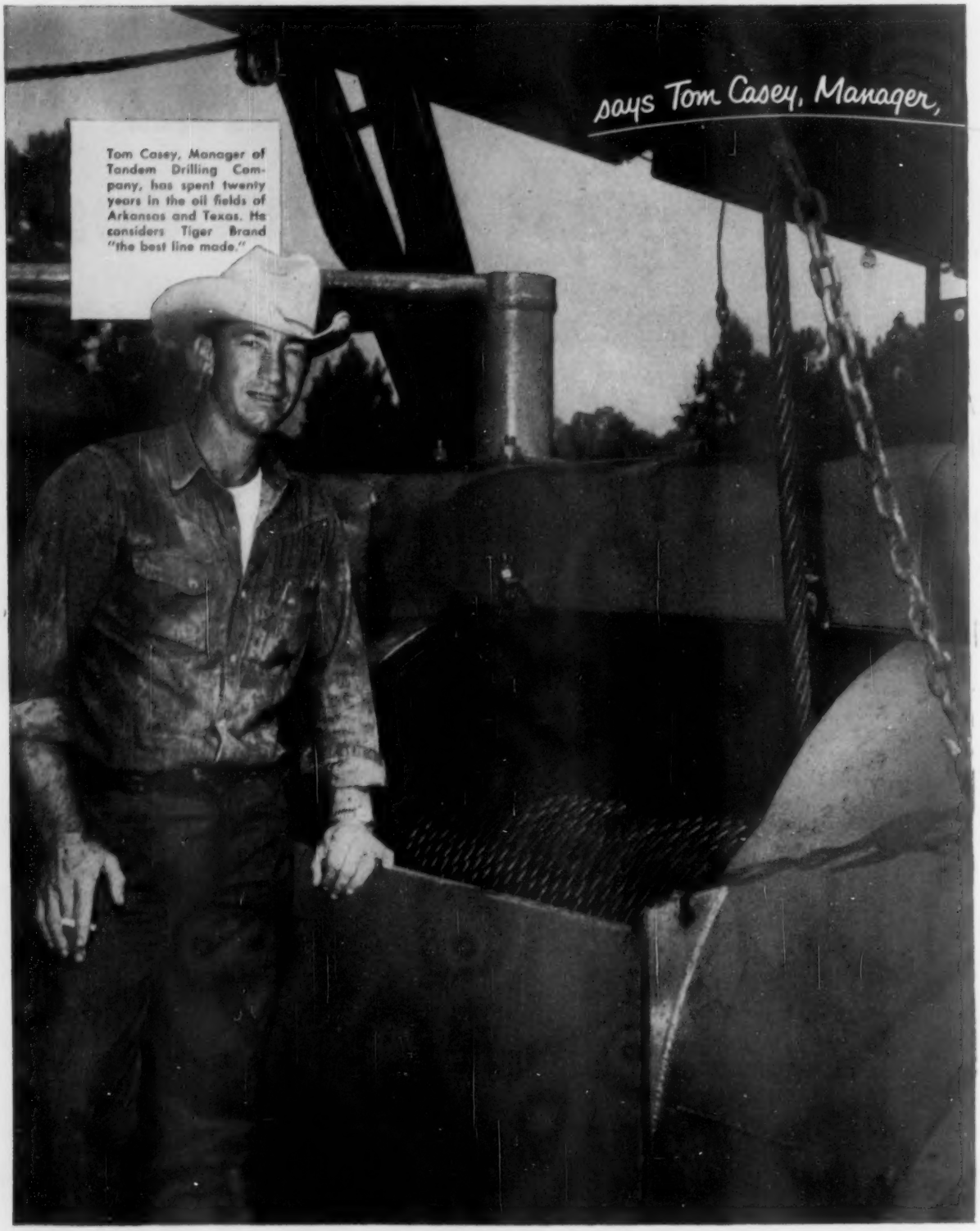
The Timken Company has already supplied such tubing for a number of extremely deep or high-pressure wells, with very satisfactory results. Actually, this only scratches the surface of our experience with high-pressure seamless tubing. For over 24 years we have been making it for many other special requirements.

FREE ENGINEERING STUDY. A recent study by the Timken Company metallurgists discusses various alloys for high-strength and corrosion-resistant tubing, and their physical properties. Write for your free copy of "Timken Oil and Gas Well Tubing" to: The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable: "TIMROSCO".

YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING

"Tiger Brand Line costs us


says Tom Casey, Manager,
Tom Casey, Manager of Tandem Drilling Company, has spent twenty years in the oil fields of Arkansas and Texas. He considers Tiger Brand "the best line made."

only 11.9¢ per ton mile

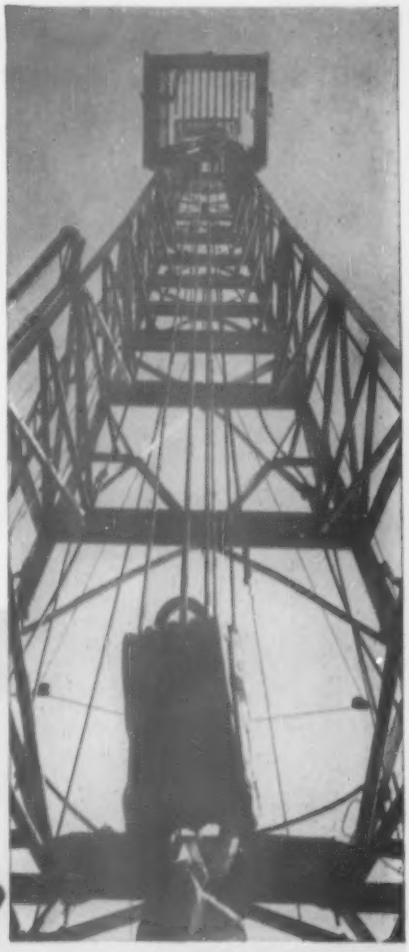
in Arkansas' East Schuler Field"

Tandem Drilling Company, Camden, Arkansas

53,550 feet of hole from a 1450-foot Tiger Brand Rotary Drilling Line—the equivalent of about *nine* average wells. Drilled at an average rope cost of less than 12¢ a ton-mile. Through sand, shale, limestone, sweet and sour gas, condensate, crude oil, salt water.

"We couldn't ask for better service," says Tom Casey. "We tried two competitive lines. But each one lasted only a third as long as this Tiger Brand Line. Now we use Tiger Brand exclusively."

If you want long lasting lines, *low cost* lines, do like Tandem Drilling Company—use Tiger Brand.



Tandem Drilling Company needs a line that can take a maximum stress of 120,000 pounds and give them a safety factor of 5 to 1, so this driller uses 1⅛" Tiger Brand *Excellay* Line with wire rope core.

This rig is going 24 hours a day. About every 1,000 ton miles the drilling line is cut-off to increase rope life. Tiger Brand is used for derrick, jerk, and tong lines, as well as drilling line.

SEE THE UNITED STATES STEEL HOUR. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

AMERICAN STEEL & WIRE DIVISION, UNITED STATES STEEL
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
GENERAL OFFICES: CLEVELAND, OHIO
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS AMERICAN TIGER BRAND WIRE ROPE

Excellay Preformed

USS

UNITED STATES STEEL

Standard Oil Company of California installs

122,700 CFM TURBO-BLOWER

for new 55,000 bbl Cat Cracker

Outdoor Installation at El Segundo Refinery also includes the world's largest centrifugal gas compressor in catalytic service . . . both by Ingersoll-Rand

THIS INSTALLATION at Standard Oil Company of California's huge El Segundo refinery is unique in three respects.

The 122,700 cfm I-R Turbo-Blower shown in the background is one of the largest ever supplied for refinery service. It is a 3-stage unit, driven by an I-R 10,000 hp steam turbine, delivering air at 19.35 psig to the 55,000 barrel per day cat cracker.

In the foreground is the largest centrifugal refinery gas compressor in the world—a 6370 hp I-R unit consisting of two centrifugals in tandem, driven by an I-R turbine. Compressing gas from 4 psig to 205 psig, it delivers 20,800 cubic feet per minute.

The entire installation is out of doors.

Whatever *your* requirements for refinery air or gas compression, Ingersoll-Rand's unequalled experience and facilities are at your service.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

12-191

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO-BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

VALVE OPENING *equals* PIPE OPENING

4" valve port ... area—12.75 sq. in.

4" pipe ... area—12.73 sq. in.

That's the formula of success behind **acf** Rectangular Port Valves! Because they have a port area at least equal to the pipe itself ... turbulence and loss of head pressure are held to a minimum ... even when handling heavy slurries and other viscous ladings.

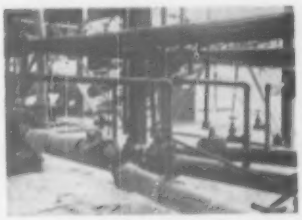
All **acf** *Cylindrical* Lubricated Plug Valves ... both those with rectangular and round port openings ... feature split-second, quarter-turn shut off that meets the rigid control requirements in the petroleum, natural gas, and processing industries. Maintenance is especially low because they are fitted with TEFLON* gaskets to prevent head leakage, and have no line seats exposed to fluid flow.

ACT NOW TO KEEP DOWN VALVE MAINTENANCE COSTS!

Representatives in 50 Principal Cities. Write for Descriptive Catalog 5-OG, **acf** Industries, Incorporated, Valve Division, 1501 E. Ferry Avenue, Detroit 11, Mich.

*DuPont Tradename

On Petroleum Applications



In Chemical Plants

In Sewage Treatment

acf CYLINDRICAL FULL PIPE AREA **PLUG VALVES**

MEETING TODAY'S *and tomorrow's* REFINING NEEDS

HIGHER OCTANE
HIGHER QUALITY PRODUCTS

LOWER EQUIPMENT COSTS
LOWER OPERATING COSTS

Now is the time to be thinking about the future. Higher compression ratios in 1956 automobiles mean a demand for a higher quality product and with 100-octane gasoline in the near future.

Let us talk with you regarding *catalytic reforming*. You will be interested in knowing how this can help you to meet new octane levels. A telephone call, wire or letter will bring quick response, without obligation. TRECO's expansion program enables us to have the staff to continue to guarantee you a new unit in less than a year.

TRECO
REFINERY ENGINEERING Company
TULSA TORONTO

DRILLING ROCK FASTER WITH A GARDNER-DENVER TWINDRIL®

The Gardner-Denver Twindril keeps your cat-skinner busy moving down the trench—as it drills twin holes every minute or two. Rugged. Easy to use. Powered by the Gardner-Denver Portable that tags along uphill or down. Bulletin WD-1.

Tractor Jumbo complete with Compressor and Rock Drills on Hydraulic Booms provides an efficient and maneuverable drilling unit. Tractor-Mounted Compressor can also be used with the Twindril. Bulletin J-100.

GARDNER-DENVER Since 1859

KELLER TOOLS

GARDNER-DENVER

THE QUALITY LEADER IN COMPRESSORS, PUMPS AND ROCK DRILLS FOR CONSTRUCTION, MINING, PETROLEUM AND GENERAL INDUSTRY

Gardner-Denver Company, Quincy, Illinois

In Canada: Gardner-Denver Company (Canada) Ltd., 14 Curity Avenue, Toronto 16, Ontario

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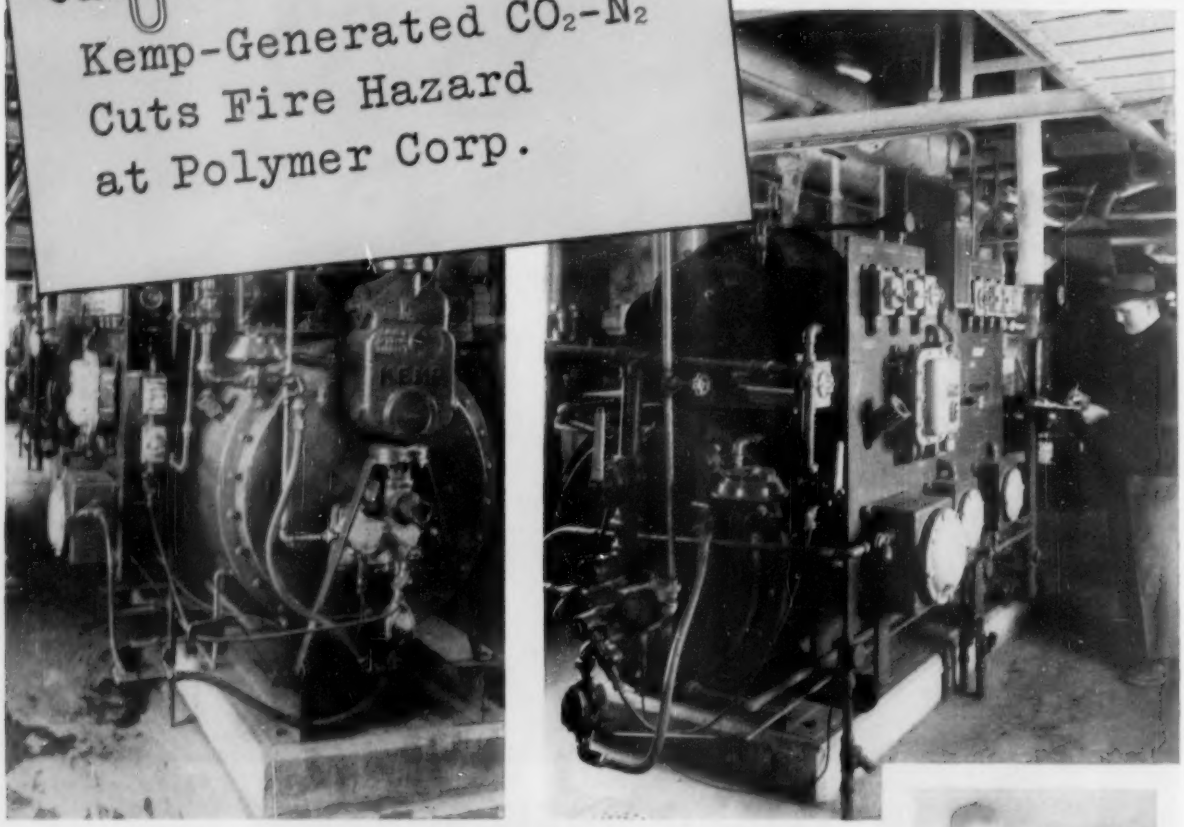
Continental Supply Co., Continental Bldg., Dallas Texas • Export Division: 30 Rockefeller Plaza, New York, N. Y.
Republic Supply Co., (Of Calif.), 2600 S. Eastland Ave., Los Angeles, Calif.

Case No. 62

Kemp-Generated CO_2-N_2 Cuts Fire Hazard at Polymer Corp.



How Polymer operated day and night for 10 years at maximum safety

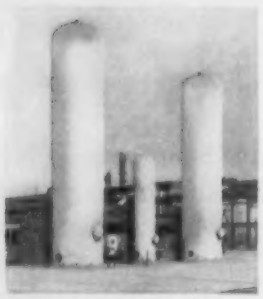
When Polymer Corporation, Ltd., Sarnia, Ontario, began operations in 1943, inventory included two Kemp MIHE Inert Gas Generators. Since that date, Polymer—and its Kemp equipment—has been operating 24 hours a day, 365 days a year. The huge quantities of man-made rubber and associated chemicals it produces—200,000,000 pounds during one year alone—reach, in one form or another, the four corners of the world.

Kemp Plays an Important Role

The high volatility of many of the ingredients used in this giant operation necessitates blanketing and purging vessels after use. It is in this step that Polymer employs Kemp Generators to assure safe, trouble-free performance. The gas they produce is piped to different operations over the entire company area—it *must* be clean! Kemp does the job—Polymer knows that it can depend on Kemp to deliver a *clean inert at a specific analysis, regardless of demand*. And every Kemp Generator is engineered for fast starts and easy operations that save *time* and *money*.

Kemp Can Do a Job for You

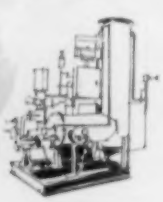
Kemp superiority is no accident. It is based on years of experience . . . on quality of design to meet specific problems. Every Kemp design features the Kemp Industrial Carburetor for complete combustion without tinkering or waste . . . for simplified installation and maintenance. Every Kemp design includes the latest fire checks and safety devices. If you have a blanketing or purging problem, contact Kemp engineers. They will be glad to study your situation and recommend the installation best suited to your needs. No obligation, of course.



Gas generator building from which inert gas is piped over 130 acres of company property at Polymer's Sarnia, Ontario, operation.

For more complete facts and technical information, write for Bulletin I-10 to: **THE C. M. KEMP MFG. CO., 405 East Oliver Street, Baltimore 2, Md.**

KEMP OF BALTIMORE



INERT GAS GENERATORS

CARBURETORS • BURNERS • FIRE CHECKS
METAL MELTING UNITS • ADSORPTIVE DRYERS
SINGEING EQUIPMENT

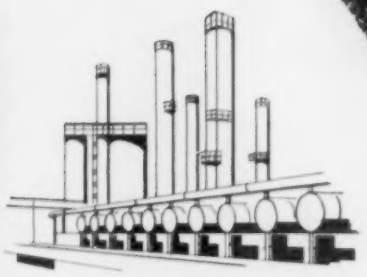
FIRST *to help put the future in East Texas oil production . . .*

Back in the early '30s, when the East Texas oil field was "wide open," the oil industry faced a major problem of price deflation. Through the guidance of the First National Bank in Dallas, proration problems were licked and prices were stabilized. Pioneering a new concept of financing for independent producers, the First provided a new method of making oil loans by helping to establish oil in the ground as a bankable commodity.

FIRST NATIONAL BANK in Dallas

Member Federal Deposit Insurance Corporation

put FIRST financing in your own oil future



a tight fit is an advantage here

IT PAYS TO LOOK AT THE ADVANTAGES OF USING GLOBE SEAMLESS WELDING FITTINGS

Welded Construction Assures Minimum Pressure Loss — True circularity and radii, uniform wall thickness, and smooth inner walls reduce friction, turbulence and subsequent erosion, adding to piping system life.

Welded Construction is Easily Insulated—Insulation is simplified by the absence of complex flanged assemblies. Because joints are leakproof, insulation is permanent and maintenance free.

Welded Construction is Simple to Install—Dimensional accuracy of angles, radii, and bevels, assure quick and easy joining. Any qualified welder can do the job efficiently and economically.

Whole Sections Can Be Shop-Fabricated — For fast installation, or where working space is limited, entire sections can be shop-fabricated and installed by any qualified welder in a few minutes.

Welded Construction is Permanent — Maintenance costs are kept at a minimum because piping is permanent and leakproof. The strength of the weld approaches that of the pipe itself.

Welded Construction is Lightweight — Strength combined with lightweight permits easy handling in installation. Unwieldy sections can be joined on the ground, and then fastened into position.

District Sales Offices: BEAVER FALLS, PA. • BOSTON 16, MASS. • CHICAGO 3, ILL. • CINCINNATI 6, OHIO • CLEVELAND 14, OHIO • DETROIT 26, MICH. • HOUSTON 19, TEX.

Design for Compactness with Globe Seamless Welding Fittings

Consider these important advantages in making extra plant space available. Note how the elimination of flanges and bolts can simplify the entire structure.

True circularity and uniform wall thickness throughout the entire cross-section enables special odd angle cuts to be made when necessary, and still be aligned with the pipe.

Compact piping systems are easily managed through the use of welding fittings. They permit close-nesting in corners, or against walls and ceilings.

The right selection of many possible shapes offers limitless possibilities of piping design to fit almost any space available.

here's how GLOBE SEAMLESS ALLOY WELDING FITTINGS SAVE SPACE IN A PIPING INSTALLATION

Welding fittings permit simplified design of a piping system. They present a compact, streamlined layout . . . the absence of bolts and flanges allow piping lines to be close-nested, or to hug walls, ceilings or plant equipment. The joint between fitting and pipe, in welded construction, is virtually flush, with the weld metal forming a solid, tough structure whose strength approaches that of the pipe itself. True circularity and uniform wall thickness enable the fitting to be cut at odd angles when necessary, and still match the pipe for perfect welding.

Globe Seamless Welding Fittings

GRADES: Carbon, Alloy and Stainless Steels.

TYPES: Elbows, Tees, Caps, Saddles, Laterals, Nipples, Returns, Flanges, Stub Ends, Reducers, Crosses, Bull Plugs.

SIZES: Complete range of sizes and schedules.

THE *NATURAL* SOURCE FOR ALLOY FITTINGS

B&W

TUBULAR PRODUCTS DIVISION

THE BABCOCK & WILCOX COMPANY

Tubular Products Division • Fittings Department

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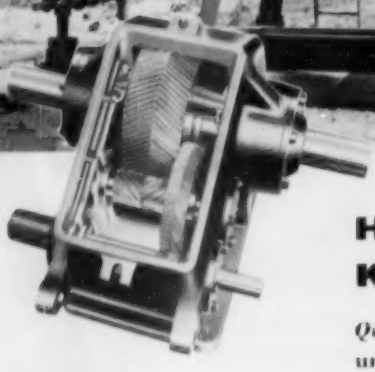
FA-5906

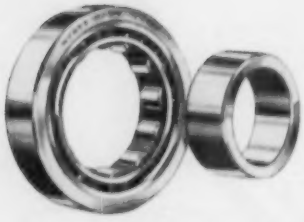
LOS ANGELES 17, CAL. • MILWAUKEE 46, WIS. • NEW YORK 16, N. Y. • PHILADELPHIA 2, PA. • ST. LOUIS 8, MO. • SAN FRANCISCO 3, CAL. • SYRACUSE 2, N. Y. • TULSA 3, OKLA.



HYATTS AND HERRINGBONES KEEP OIL FLOWING FOR LESS!

Quality construction in every detail is one of the big reasons why Alten pumping units have earned such a reputation for low-cost, dependable performance.

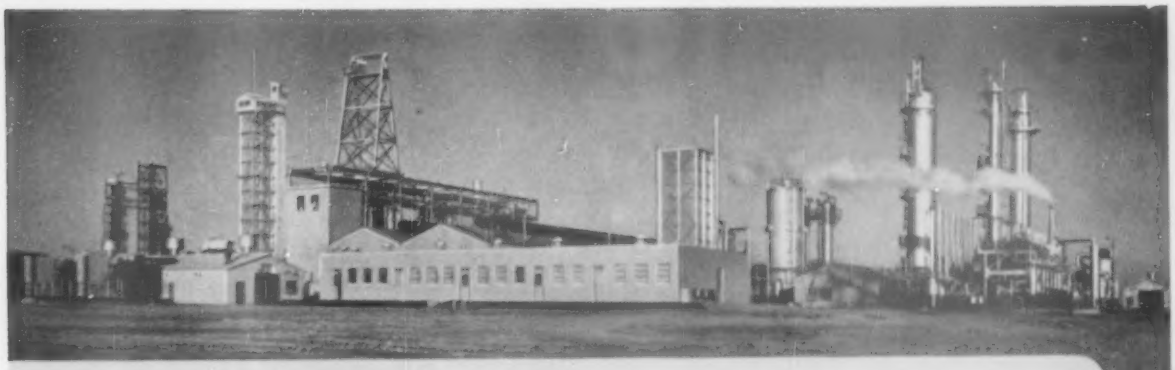
For example, the gear reducer for the heavy-duty unit (shown above) features herringbone gears for maximum load-carrying ability. But Alten doesn't stop there; to assure wear-saving automatic alignment of all gears and pinions, the intermediate and high-speed shafts are fitted with *full-floating straight radial HYATT Hy-Load Roller Bearings.*



Only straight radial bearings permit gears to align themselves for most efficient operation—and *HYATT makes the finest, most complete line of straight radial roller bearings in the world.* When you specify HYATT Hy-Loads you're *sure* of top quality, easier assembly, complete interchangeability of parts—*and you have a complete range of types and sizes to choose from!* Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS

STRAIGHT BARREL TAPER



ANHYDROUS AMMONIA... 250 tons per day

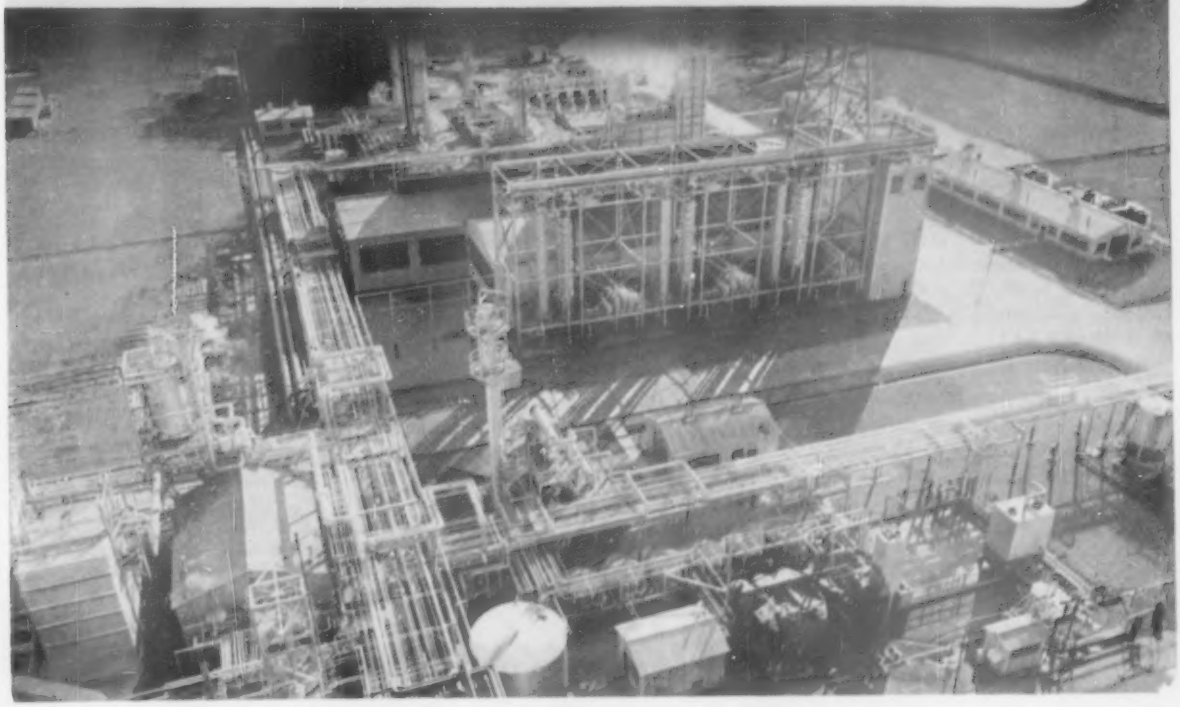
by the exclusive FW sequence

Another Ammonia Synthesis Plant by Foster Wheeler now on stream at Grace Chemical Company

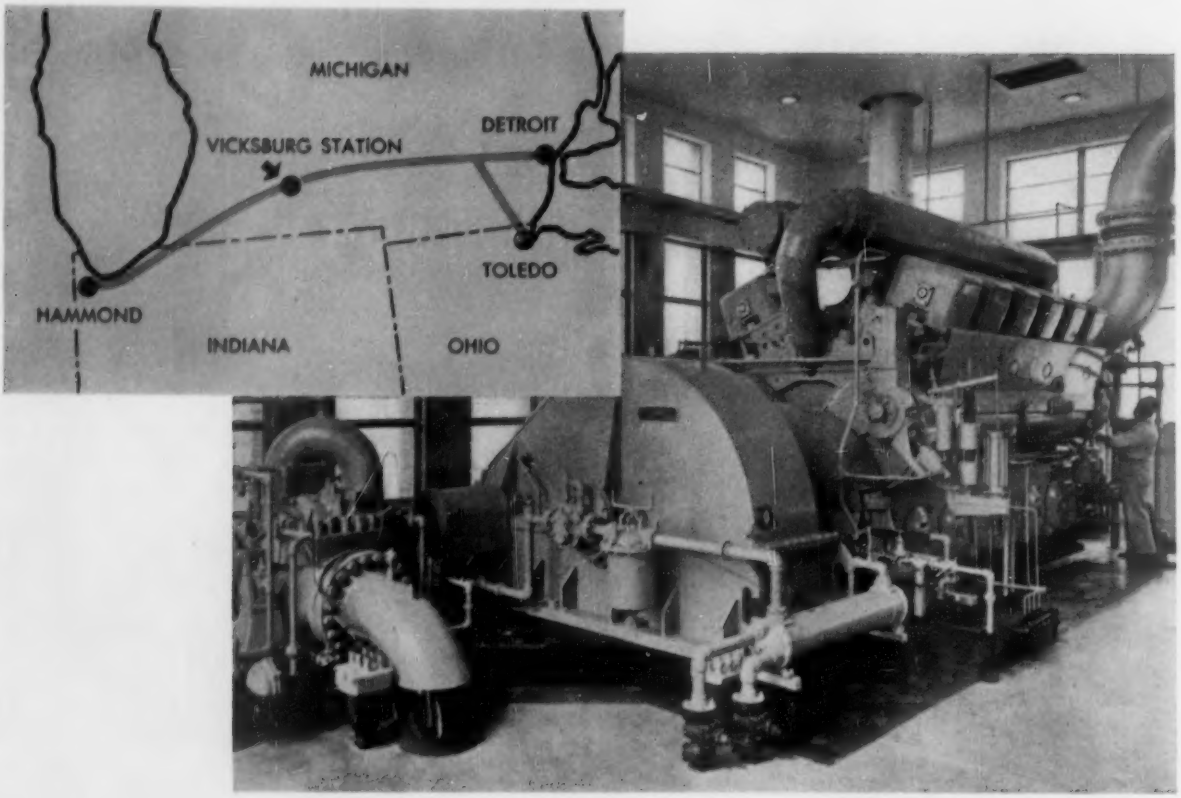
Designed and built by Foster Wheeler, this modern Grace Chemical Co. plant at Memphis, Tenn. has a capacity of 250 tons of anhydrous ammonia per day.

It is another outstanding example of the proved economy and dependability of the FW Sequence — Texaco partial oxidation, FW liquid nitrogen wash and Casale ammonia synthesis. Write for the March-April issue of Heat Engineering, containing the complete story. *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

FOSTER WHEELER



FARREL® SPEED INCREASER SERVES 4,000,000-GALLON CAPACITY WOLVERINE PIPE LINE



295 miles of welded steel pipe 16 inches in diameter, with a present capacity of 4,000,000 gallons of petroleum products a day—that's the Wolverine Pipe Line. The 4,000,000 gallons may be boosted to 7,350,000 by adding more pumping stations.

At the Vicksburg station, pumping power comes from a 12-cylinder, 2500 HP Diesel, which will later be increased to 3200 HP. This engine drives a single pump through a Farrel speed increaser, which steps up the 500 RPM of the engine to the pump speed of 5100 RPM.

Because of the vital, continuous service it provides, a Farrel speed increaser was the choice for this pipe line installation, as it has been for many others over the years. Of the hundreds and hundreds of these units installed since 1932, when these units were first developed, not one has ever had to be replaced.

This record is worth remembering when you are in the market for speed increasers. It provides a virtual guarantee of trouble-free operation. Ask for our bulletin 448-A.

FARREL-BIRMINGHAM COMPANY, INC.
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Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.
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OIL FIELD REPRESENTATIVES:
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FB 987

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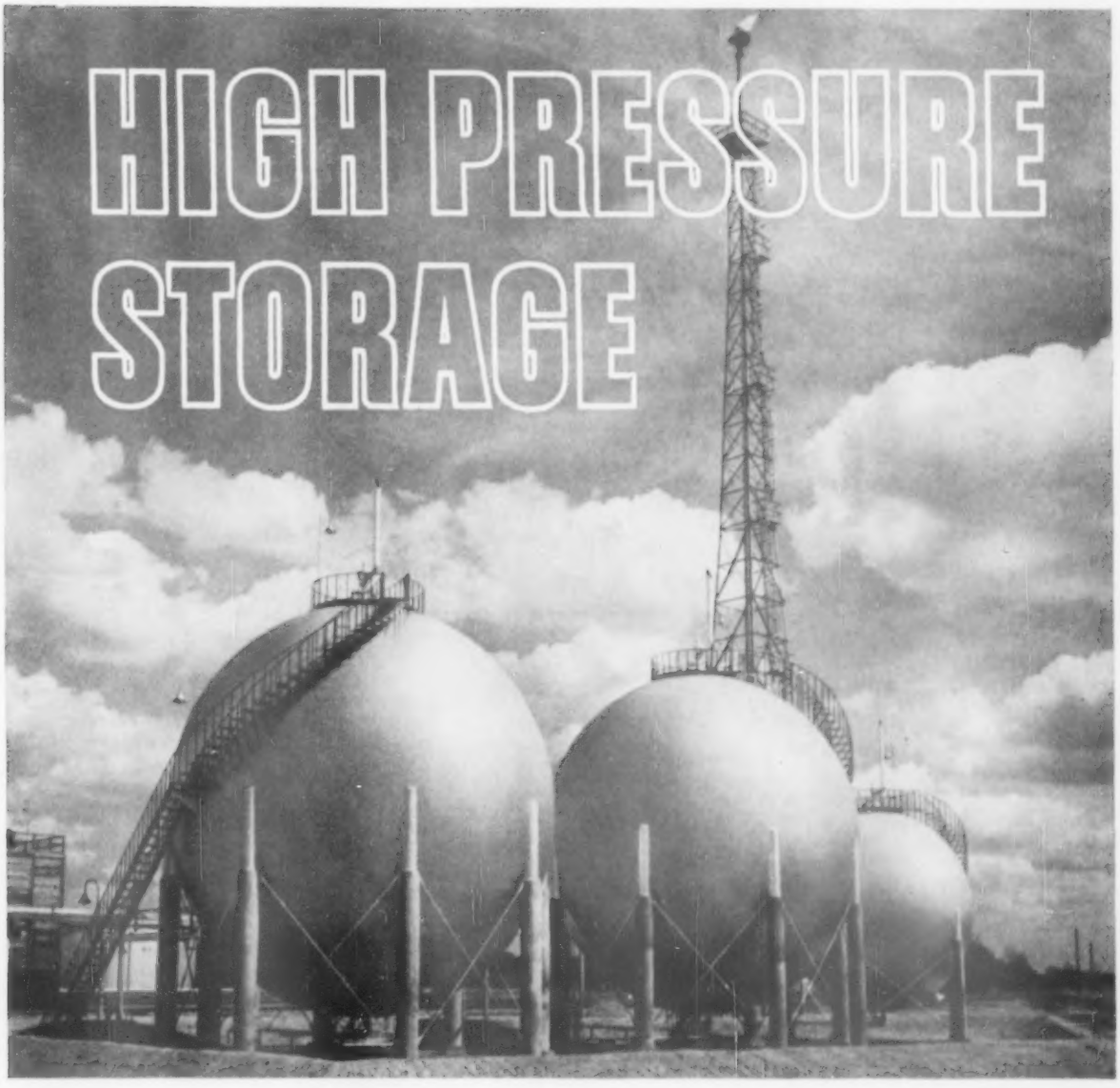

GRAVERSPHERES

solve gas and liquid storage problems

For pressure storage of process butane, iso-butane, natural gasoline and other volatile liquids and gases, Graverspheres are a "natural."

Graverspheres are formed in Graver shops and are first carefully assembled to insure accurate fit. After this they are shipped to location, erected and field-welded.

These spheres—the very shape of which is ideal for high-pressure storage in quantity—are available in capacities from 1,000 to 30,000 bbl. For gas storage Graverspheres are made to withstand pressures up to 100 p.s.i.g. and for liquid storage from 20 to 90 lb. water pressure.

As is the case with Graver tanks, towers and pressure vessels, traditional Graver quality and craftsmanship are inherent in Graverspheres.

GRAVER TANK & MFG. CO., INC.
EAST CHICAGO, INDIANA
CHICAGO • NEW YORK • PHILADELPHIA • EDGE MOOR, DEL.
CATASAUQUA, PA. • PITTSBURGH • CLEVELAND • DETROIT • TULSA
SAND SPRINGS, OKLA. • HOUSTON • ODESSA, TEXAS • CASPER, WYO.
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GRAVER builds tanks, towers and pressure vessels for the chemical and petroleum industries

Depend on LADISH

- Carbon Steels
- Carbon-Molybdenum Steels
- Chromium-Molybdenum Steels
- Nickel Steels
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- Wrought Iron
- Chromium Type Stainless
- Chromium-Nickel Stainless
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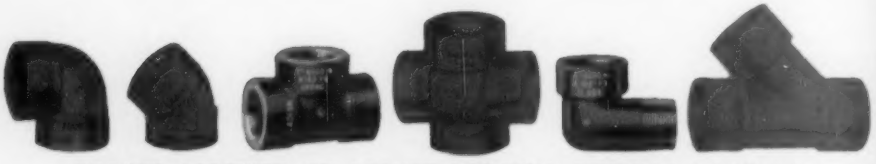
- Aluminum-Copper Alloys

BUTT WELDING FITTINGS

½ inch through 42 inches . . .

FORGED CORROSION RESISTANT—LIGHT WEIGHT and A.S.A. FLANGES

½ inch through 24 inches . . .



FORGED SCREWED OR SOCKET WELDING FITTINGS and UNIONS

⅛ inch through 4 inches . . .

LARGE DIAMETER AND T.E.M.A.* STANDARD FLANGES up to 20 feet O.D.

*Tubular Exchanger Manufacturers Association

LONG WELDING NECKS up to 24 inches, 150 lb. through 2500 lb.

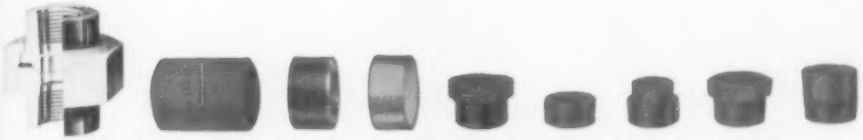
Complete Service . . .

BUTT WELDING FITTINGS

Schedules 5S, 10S, 40S, 80S, and other Schedules and wall thickness.

FORGED CORROSION RESISTANT—LIGHT WEIGHT and A.S.A. FLANGES

150 lb. through 2500 lb. pressure ratings.



FORGED SCREWED OR SOCKET WELDING FITTINGS and UNIONS

150 lb. Corrosion Resistant and 2000 lb. through 6000 lb. ratings.

FOR FITTINGS FROM ANY FORGEABLE MATERIAL TO MEET YOUR SERVICE REQUIREMENTS

You get prompt, efficient service when you specify and order from the complete Ladish Controlled Quality line. Fittings *in any forgeable material* in virtually every type, size, wall thickness or pressure rating . . . are produced to one uncompromising Controlled Quality standard . . . and identified with heat code symbols pioneered by Ladish as verification of metallurgical integrity resulting from exhaustive tests made in the Ladish metallurgical laboratories.

For *complete service* on your fittings requirements, depend on the Ladish line and the services of your Authorized Ladish Distributor.

THE COMPLETE *Controlled Quality* FITTINGS LINE

LADISH CO.

CUDAHY, WISCONSIN

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- Deoxidized Copper
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- Titanium
- Forging Brass
- Everdur Bronze
- Silicon Bronze
- Manganese Bronze
- Wrought Nickel
- Nickel-Copper Alloys
- Inconel
- Monel

Cross-country transportation. There's nothing like 4-wheel drive for getting through mud, sand and rough ground. That's why leading oil companies rely on Universal 'Jeeps' and 'Jeep' Station Wagons for inspection trips on leases and for transporting tool pushers and equipment to off-road locations.

Tough jobs like yours demand 4-wheel drive!

Geologists use the 4-wheel-drive 'Jeep' Station Wagon as a camp on wheels. It goes almost anywhere, with plenty of room for equipment, and provides ample sleeping space, as well.

Drilling shot holes The 'Jeep' Truck, with its go-anywhere 4-wheel drive, is ideal for drilling shot holes in remote places. With power take off, it operates a mobile drill for borings as deep as 300 feet.

Pipeline inspection The 4-wheel-drive Universal 'Jeep' can follow a pipeline up 60 per cent grades, and through water 2 feet deep. It takes men and tools to do the job in any weather, over any kind of terrain.

The oil and gas industry always moves out ahead of roads. You have to go into rough country to find oil or gas and bring it out—and you need vehicles that will do a job in rough country every day, regardless of road and weather.

Only 4-wheel drive vehicles can do that kind of job. Ask your 'Jeep' dealer for a demonstration, or write to Willys Motors, Inc., Toledo 1, Ohio.

How does 4-wheel drive work? 4-wheel drive vehicles offer selective 2 or 4-wheel drive, the engine power is transmitted to all four wheels at once, rather than to the rear wheels alone, thus, utilizing the entire weight of the vehicle for maximum traction. A special low-gear range provides extra pulling power, when needed.

the **'Jeep'** *family of* ***4-wheel drive*** *vehicles...* ***world's most useful vehicles***

WILLYS MOTORS, INC., TOLEDO 1, OHIO

They Say—

McKay on Imports, Natural Gas

"I would not like to see the federal Government step in and lay down rules for the control of oil imports, nor would I like to see our domestic oil industry hurt by excessive imports. . .

"My belief is that the American people are the best judges of what they want for themselves.

"I don't like the thought of our bureaucracy in Washington telling the man who has built or bought his own home how and with what fuel he should heat it, and that applies with the same force to a man who has built a factory, a store, an apartment house, or anything else. . ."

Secretary of Interior Douglas McKay in an address before a Chicago meeting of the Oil Heat Institute.

Canada Can Take a Lesson

"In order to obtain an immediate benefit by way of (Canada's) depletion allowance . . . a taxpayer would have to abandon—or at least curtail—any further expenditures for exploration work and confine his attention to the producing properties which he has already acquired. In other words, if a taxpayer continues to search for new reserves—the very thing which the depletion allowance is intended to encourage—he will . . . be effectively prevented from obtaining any immediate benefit from depletion allowance.

"The depletion allowance under United States tax laws has played a vital part in the development of the oil and gas reserves of that country. Our Canadian tax authorities might do well to review our whole system of depletion allowance . . . with a view to revision along the tried and proven pattern of the more practical U. S. system.

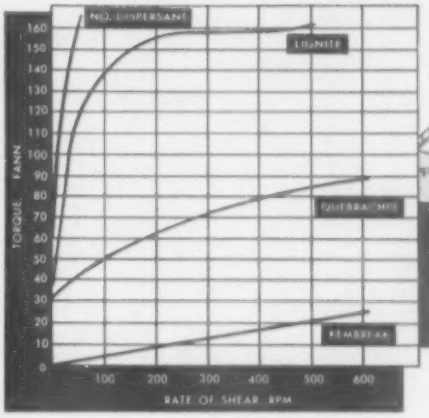
". . . Governments too eager to tax at the gas pump or anywhere else, or authorities not fully sympathetic to the special problems of oil development, could set in motion complex reactions detrimental to the industry, and in consequence, to the entire economy. . ."

J. Gerald Godsoe, executive vice president, British American Oil Co., Ltd., in addressing shareholders at their annual meeting in Toronto.

The Highway Program

"The enthusiasm for the objective of an expanding highway program must not blind us to the fact that the costs are high and programs must be soundly

KEMBREAK*
DISPERSES LIME TREATED MUD
. . . even without caustic!



COMPARISON OF DISPERSANTS IN A LIME TREATED SYSTEM:

INERT, NON-SWELLING SOLIDS	13.2 lbs./gal.
DISPERSANT	3.2 lbs./bbl.
FILTRATE Ca++	750 ppm
NaOH	0

The "mud" used to develop the curves shown here is not one you'd want to use for making hole. But in the laboratory it serves very well to illustrate the superiority of Kembreak over other commonly used dispersants in lime treated muds.

Note how well Kembreak disperses a mud system having a high calcium ion concentration — without the addition of caustic. And, of course, this dispersant performs equally well in low lime — low caustic drilling fluids and conventional lime base muds.

Furthermore, Kembreak muds are virtually unaffected by the contaminants encountered in normal drilling, e.g.: gypsum, anhydrite, cement, salt, lime, limey shales, and clay. Kembreak is a stabilizer, too, for oil-in-water emulsions . . . making it doubly useful in lime treated emulsion muds.

Guard against drilling failures, whenever difficult hole conditions are expected, by using muds made with Kembreak.

*Kembreak is a trade name for Marathon Corporation's neutral calcium lignosulfonate.†

It is the only lignosulfonate product proved by years of successful use in oil well drilling.

†patented

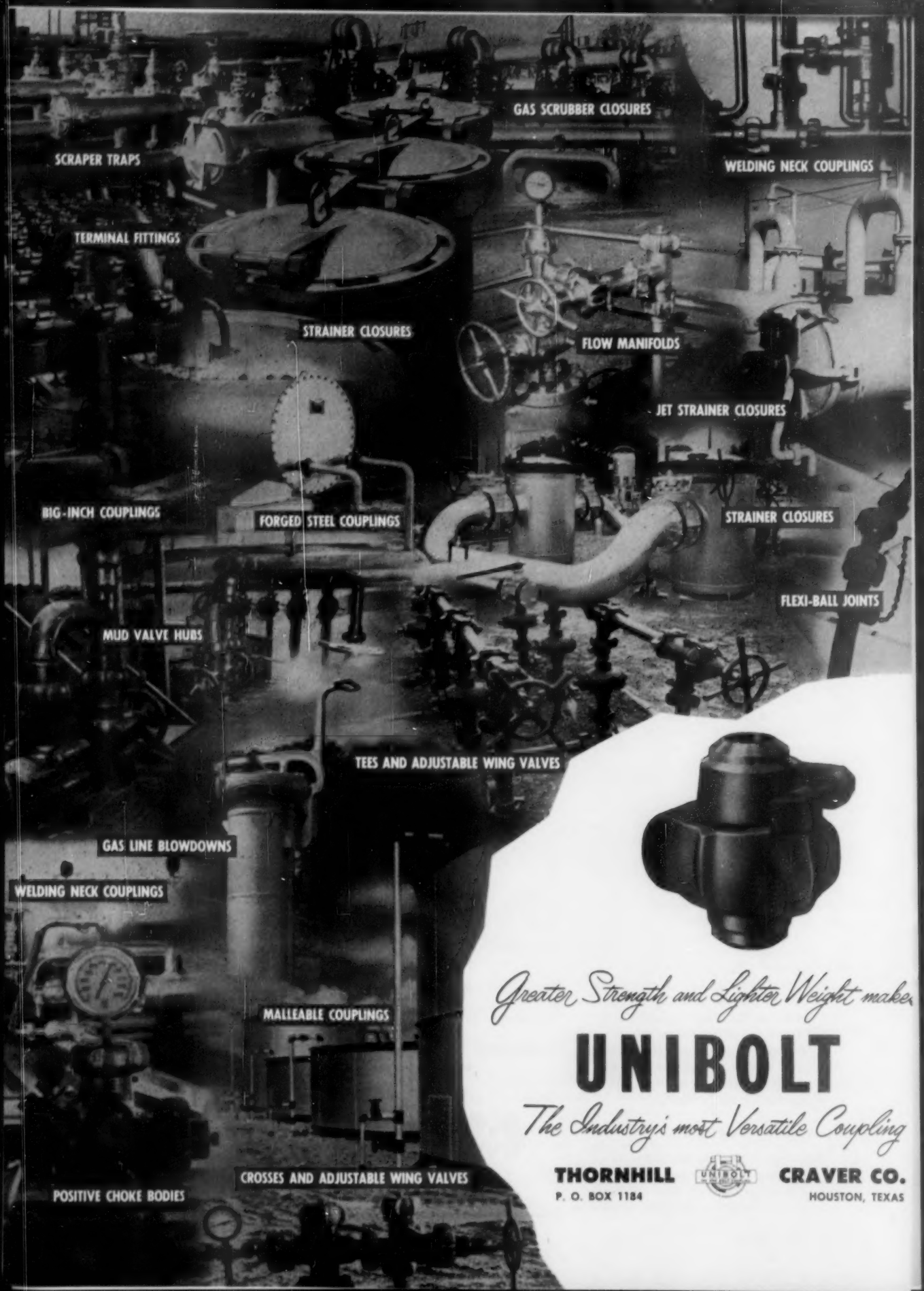
KEMBREAK†
may be obtained from

MAGNET COVE BARIUM CORP.
HOUSTON, TEXAS

MILWHITE MUD SALES CO.
HOUSTON, TEXAS

†Reg. T.M., Accuracy Rig Tool Company

MARATHON *Corporation*
CHEMICAL SALES DEPARTMENT
ROTHSCHILD • WISCONSIN



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The Industry's most Versatile Coupling

THORNHILL CRAVER CO.

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financed and carried out with a minimum of inefficiency and waste. . .

"From our study, we have concluded that continuing to vest the major responsibility for highway improvements in the state governments offers the surest, most equitable, and most efficient means of achieving the desired goal of adequate and continuing highway development at reasonable cost.

"If this proposal (that federal gasoline tax be linked with federal highway aid) were to be adopted, it would amount to abandoning the time-tested federal highway-aid program. For that eminently successful program, the national Government would be substituting a procedure that amounts to collecting a tax for the states, shuffling the revenue around a bit, and returning it with a deduction for federal administrative expenses. That certainly is not federal highway aid in the traditional sense. . ."

Frank M. Porter, president, American Petroleum Institute, in a statement issued following an A.P.I. directors meeting in Denver.

Illinois Gas Consumers Happy

"The problem of chief concern today to our public utility gas companies and to me as governor of one of the largest gas-consuming states is the finding of additional reserves of gas to assure an adequate future supply of this most desirable fuel.

"The Illinois consumer is already protected against overcharges by the rate-regulating authority of the Illinois Commerce Commission.

"Far from experiencing a sky-rocketing increase in rates, the people of my state have enjoyed practically stable gas rates in a time when the cost of nearly everything else has climbed steeply upwards. In this regard, the cost of living increased 54 per cent from 1945 to the end of 1954. In contrast, the averages of typical monthly gas bills for five important Illinois cities have changed as follows: monthly use 10 therms, a decrease of 12 per cent; monthly use 25 therms, a decrease of 12 per cent; and normal monthly space-heating use, an increase of 10 per cent . . ."

Gov. William G. Stratton of Illinois, chairman of the Interstate Oil Compact Commission, in an address before the San Antonio meeting of the Independent Petroleum Association of America.

Imports and Venezuela

"The increase in exports to Venezuela indicates that American companies will have a billion-dollar market there shortly.

"However, since 95 per cent of

FRANKLIN PARK

Sets the Pace for QUALITY PROTECTION

AT ALL 7 PLS PLANTS

Where experience and the most modern facilities are combined to give you more for your money in cleaning, priming, coating and wrapping steel pipe.

PLS-Franklin Park is strategically located within the Chicago switching district, near Chicago, Indiana Harbor, and Gary tube mills and is served by the Chicago, Milwaukee, St. Paul and Pacific Railroad. Pipe can also be stopped off at Franklin Park for coating and wrapping and reshipment at through freight rates from eastern mills. 20 acres provide ample storage space for our customers' pipe. 93,000 square feet under roof assure prompt service at all times.

DEPENDABLE SERVICE SINCE 1931

PLS Pipe Line Service Corporation

Pioneers in Steel Pipe Protection

General Offices and Plant: Franklin Park, Illinois

Plants at Glenwillard, Penna.; Longview, Texas; Corpus Christi, Texas; Harvey, La.; Sparrows Point, Md.; and Monmouth Junction, N. J.

don't be left behind . . .

EVERY REFINER AND EVERY MARKETER REALIZES THE SIGNIFICANCE OF THE PRESENT TREND TO HIGHER OCTANES. It is a trend that predicts the future market demands for improved motor fuels to efficiently power higher compression automotive engines.

New methods . . . new techniques . . . new concepts in refining processes and equipment—all are necessary to adequately meet the refiner's needs in enabling him to produce a higher octane gasoline most efficiently and economically.

Cracking the octane barrier, Universal has provided Rexforming*—a process completely capable of solving the refining industry's most immediate and long-range problem.

In the final analysis, the refiner who can produce the products for which there is the greatest demand, and the marketer who can supply them will be building a sound economic position for the future.

Don't be left behind! Check

Rexforming

TRADE MARK

carefully . . . examine it in relation to your refining and marketing problems. Chances are that you will want to consider its immediate application to give you today's and tomorrow's octanes.

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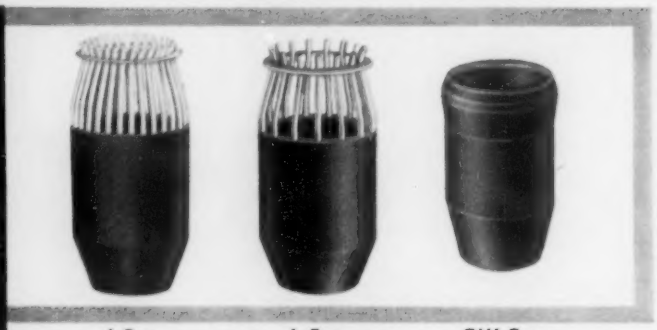
Universal Service
Protects Your Investment

**Developed by the Pioneers of Platinum Catalyst Reforming*

GUIBERSON SERVES THE OIL INDUSTRY WITH

ANY CUP

you need — for swabbing tubing, drill pipe or casing

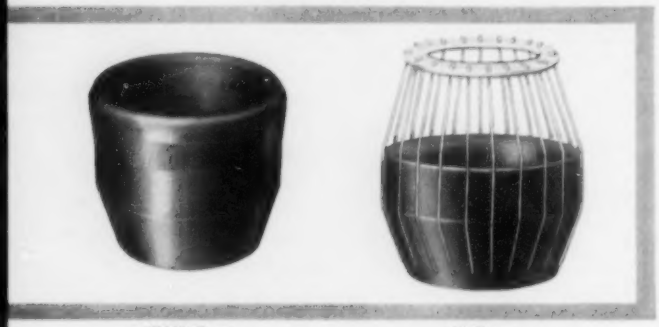


J Cup L Cup GW Cup

Tubing or Drill Pipe

ANY SIZE

you need — in swabs or swab cups. And that means all sizes, not just the popular ones

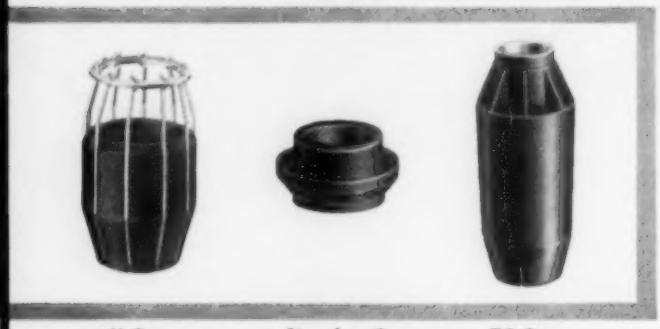


GW Cup K Cup

Casing

ANY TIME

you need them — no lost time waiting for delivery. Available immediately — check with your favorite supply store



K Cup Simplex Cup TC Cup

Tubing or Drill Pipe

Your Guiberson representative will be glad to recommend the type of swab cup best suited to your requirements.

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Sold By Leading Oil Field Supply Stores Everywhere

An OIL BANK . . .
directed by OIL MEN . . .
in the OIL CAPITAL of the World!
Think 1st of Tulsa
OUR 41th YEAR
FIRST NATIONAL BANK & TRUST CO.
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Venezuela's purchasing power is derived from its abundant oil resources, the market would be seriously crippled if restrictive quotas on Venezuelan oil are imposed by the United States. If we shackle the economy of this expanding South American nation, American merchants will lose millions of dollars worth of foreign trade with consequent loss of employment to many thousands of Americans."

Lloyd G. Smith, vice president, Creole Petroleum Corp., in a statement issued in New York.

Challenge to Oil Men

"What we must do is map ways and means of bringing up the 50 billion barrels which must remain in the ground (because we don't know how to get it) . . . It is up to you who are here today to find the ways and means . . ."

William J. Murray, Jr., chairman, Texas Railroad Commission, in an address before the West Texas Short Course on Oil Lifting Methods at Texas Technological College, Lubbock.

The Damage of Imports

"For some years now imports have supplanted rather than supplemented domestic production.

"In the U.S. as a whole today, more than 1 bbl. in 10 of the crude oil processed is imported. And in 1954, for the first time in 5 years, U.S. production showed a decrease over the previous year. The rising pressure of imports was one of the responsible factors.

"It is distinctly not in the national interest that imports continue at anything like the present rate. The effect of imports on this scale can only be to reduce incentive to find and produce oil in this country."

Dr. Robert E. Wilson, chairman of the board, Standard Oil Co. (Ind.), during a recent visit to Tulsa.

Nature Couldn't Do It

"There are those who yearn to place the public-utility collar around our necks and keep us in a strait jacket of government regimentation. Nature has not been able to separate gas from oil, and I doubt if the career men in Washington, with all their admitted omnipotence, can do this. You cannot control the one without controlling the other, and so we had just as well make up our minds that oil and gas are in the same boat as far as the threat of permanent federal control is concerned. We are going to survive or perish together.

"The practical effect of giving public-utility status to a competitive industry such as natural gas will be to

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600 AIR CONDITIONED ROOMS, ADJACENT GARAGE, Wonderful FOOD AND SERVICE
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Business and Pleasure in Tulsa means - THE MAYO
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THE GREATEST IMPROVEMENT ...FOR CENTERING CASING WHILE CEMENTING SINCE 1925
B and W
LATCH-ON CENTRALIZERS with the NEW
KON-KAVE BOW
B and W KON-KAVE BOW combines a curved cross-section, highest quality spring steel, drop forging, and the proper heat treatment to relieve all stresses created in forming and welding B and W KON-KAVE BOWS.
FIRST IN THE FIELD!
- Strongest — greatest resistance to side thrust.
- Most resistance to deformation . . .
- Easiest to install and run.

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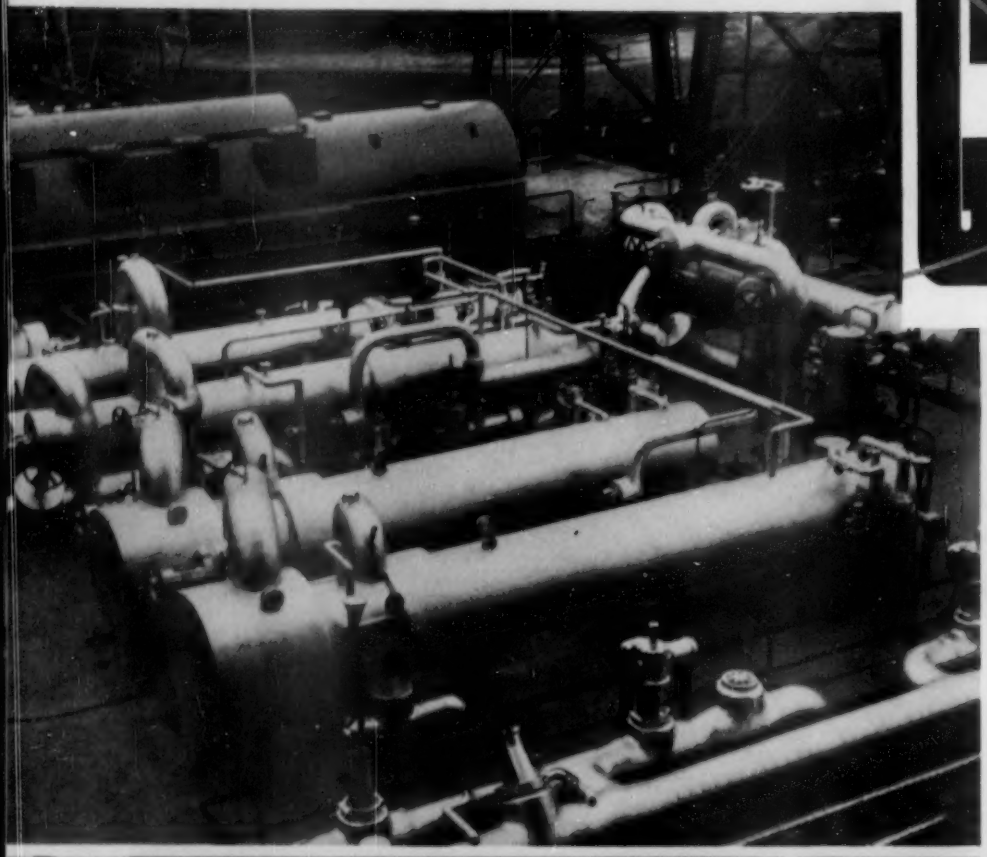


Griscom-Russell feed water heaters in a 125,000 KW public-utility power station; save nearly 100 tons of coal per day. Heaters handle flow of water exceeding 2000 G.P.M. at 2500 pounds pressure and steam extracted from the turbine at five different points; "train" of five units pre-heats water fed to boilers from 90° F. to 441° F.

Askania multiple fuel boiler control panel in large steel plant; maintains metered proportion between combustion air and fuels—coke oven gas and fuel oil—for most economical combustion; holds steam pressure constant through all load changes and keeps furnace pressure at a safe and predetermined value.

General Precision Laboratory's Industrial TV Camera, the "Bullet"; portable, easily operated; used to monitor and improve manufacturing processes and to view hazardous industrial operations.

The highly advanced technological products designed and manufactured by the eighteen producing companies of General Precision Equipment Corporation serve more than a dozen major industries. Products of six of these GPE Companies—Griscom-Russell, Askania, Librascope, Link, Kearfott and General Precision Laboratory—have widespread application in the processing and power industries.

Industrial Processing...and Power

The Griscom-Russell Company is one of the country's largest producers in the fields of heat exchange and water distillation. It is the pioneer in heat exchanger equipment—the key to the whole complex of modern industrial processing and power. For over seventy years, G-R equipment has been responsible for greatly increased efficiency and lowered operating costs in industry.

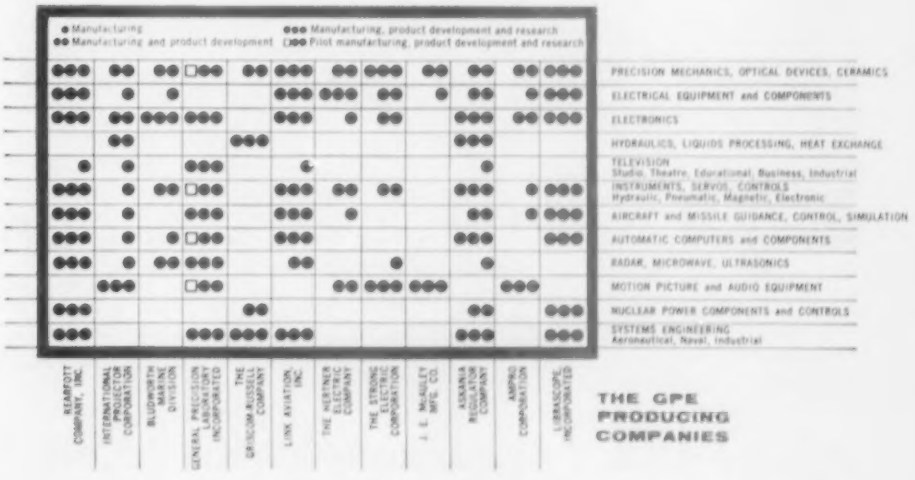
Askania Regulator Company for a quarter of a century has been a leading developer in the field of regulators and controls, including components and systems. Its products are widely used by the power, steel, gas and coke, mining, chemical, petroleum, glass and paper industries—wherever great reliability and accuracy are essential.

Kearfott Company, Inc.; Librascope, Incorporated; and Link Aviation, Inc. produce a wide variety of precision instruments, computers, servos and other control components for equipment and systems used throughout the power and the processing industries. Industrial television equipment manufactured by General Precision Laboratory Incorporated, the sixth GPE Company active in these fields, is playing increasingly important roles in "seeing eye" monitoring operations in these industries.

Each company in the GPE Group works in specific, highly specialized technical areas, as indicated in the chart below. Each of these companies, in addition to specializing in its particular products and fields of technical competence, has at its command, as required, the facilities and specialized techniques of the other GPE Companies in their respective fields. Interrelation is achieved through GPE's basic operating policy, Coordinated Precision Technology.

In the fields of research and development, GPE Coordinated Precision Technology permits a high degree of specialization in particular areas of competence and supplements such specialization by the application of techniques in other fields, as desirable. In the field of production, it makes possible a highly flexible application of facilities. This policy has been responsible for a diversified line of precision equipment of superior design and performance, covering a wide range of both standard and special uses.

Perhaps the most conspicuous advantage of GPE Coordinated Precision Technology is that the concept and development of equipment, and of solutions to the underlying technical problems, are not restricted or distorted by traditional allegiance to specialization in a particular field. GPE coordination permits the engineers and technical personnel of each GPE Company to seek the optimum solution for the customer within the total capacities of the GPE Companies as a group.



A brochure relative to GPE Coordinated Precision Technology and the work of the GPE Companies is available. Address your request, or inquiries on specific problems, to:

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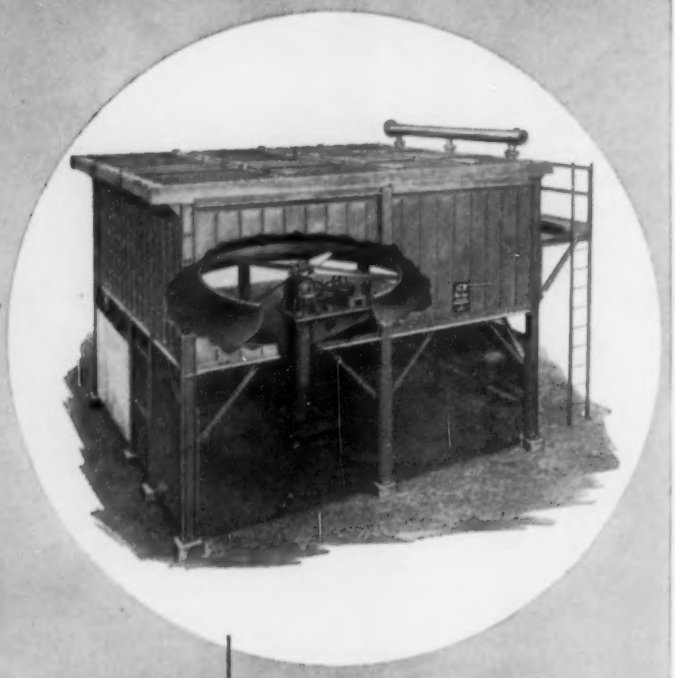
G-R fin-fan

more *than ever your best buy in*

AIR-COOLED HEAT EXCHANGERS



more *Applications*

The **fin-fan** exchanger is readily adaptable to practically every condensing and cooling application, particularly when the use of cooling water involves problems of supply, cost, scale or corrosion. Such flexibility is just one of many features, which make the G-R **fin-fan** your best investment in air-cooled apparatus.

more *Advantages*

Many important design and construction advantages are incorporated in the **fin-fan.** These include 100% effective cooling surfaces; maximum heat transfer afforded by exclusive G-R K-Fin Cooling Sections; fully prefabricated structure; predrilled supports, providing for addition of future units; *plus* bell-type fan ring for maximum efficiency with minimum horsepower required for fan.

more *Installations*

More square feet of K-Fin tubing, which forms the heat transfer surface, are being used in more types of air-cooled installations than any other design. Reason? Dependable ratings, design and workmanship backed by over 85 years of specialized experience in building quality heat transfer apparatus for varied services all over the world.

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Dependable because completely G-R

The new G-R **fin-fan,** *completely G-R,* can be depended upon for structural strength, peak operating efficiency, ease of installation, operation and maintenance. It is a complete self-sustained unit combining the best transfer service available with tested and proved air circulation equipment. As a result of exhaustive tests conducted on the complete equipment over a six month period G-R can offer you *guaranteed performance* based on actual test data. This is just one more important reason why the new G-R **fin-fan** is your best buy in air-cooled heat exchangers.

GR321

G-R HEAT TRANSFER APPARATUS

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

fin-fan Air-Cooled Heat Exchanger

discourge and deter men from assuming the extreme and unusual hazards of exploring for new resources which are necessary to the maintenance of an adequate supply of this valuable fuel. You just cannot destroy incentive without paying a penalty, and it is the American consumer who eventually will pay the price of this folly.

"Times and conditions change, but human nature remains the same. People just do not do things without an incentive. That is why nations that are under the iron heel of a dictatorship do not prosper.

"This and many other problems which face the oil and natural-gas industry today are more complex and serious than at any time since the Drake well gave birth to the industrial revolution in 1859 . . ."

Walter S. Hallanan, president, Plymouth Oil Co., and chairman, National Petroleum Association of America meeting in San Antonio

More Markets Needed

"The big target for the oil industry (in western Canada) is to close the gap between what it is able to produce and what it is able to sell. This would mean increasing markets from the present 300,000 bbl. of western crude daily to 420,000 bbl. daily."

Trevor F. Moore, vice president, Imperial Oil, Ltd., in an address before the Winnipeg Ad and Sales Club.

CALENDAR

MAY

16-18 Southern Gas Association, New Orleans.

19-20 Society of Exploration Geophysicists, 10th annual Gulf Coast meeting, Plaza Hotel, San Antonio.

20-22 Appalachian Geological Society, Virginia Geological Survey, and West Virginia Geological Survey, spring field conference, Kavannaugh Hotel, Harrisonburg, Va.

23-25 American Petroleum Institute, Division of Marketing, midyear meeting, Chase and Park Plaza hotels, St. Louis.

26-27 Western Petroleum Refiners Association, technical-industrial relations meeting, Settles Hotel, Big Spring, Tex.

26-27 American Institute of Mining and Metallurgical Engineers, Rocky Mountain Petroleum Sessions, Shirley-Savoy Hotel, Denver.

26-27 Kentucky Oil and Gas Association, annual meeting, Lafayette Hotel, Lexington.

30-June 1 Chemical Institute of Canada, thirty-eighth annual conference and exhibition, Quebec City, Que.

JUNE

1-3 Tenth annual Short Course on Gas Technology, Texas College of Arts and Industries, Kingsville, Tex.

5-9 Canadian Gas Association, annual

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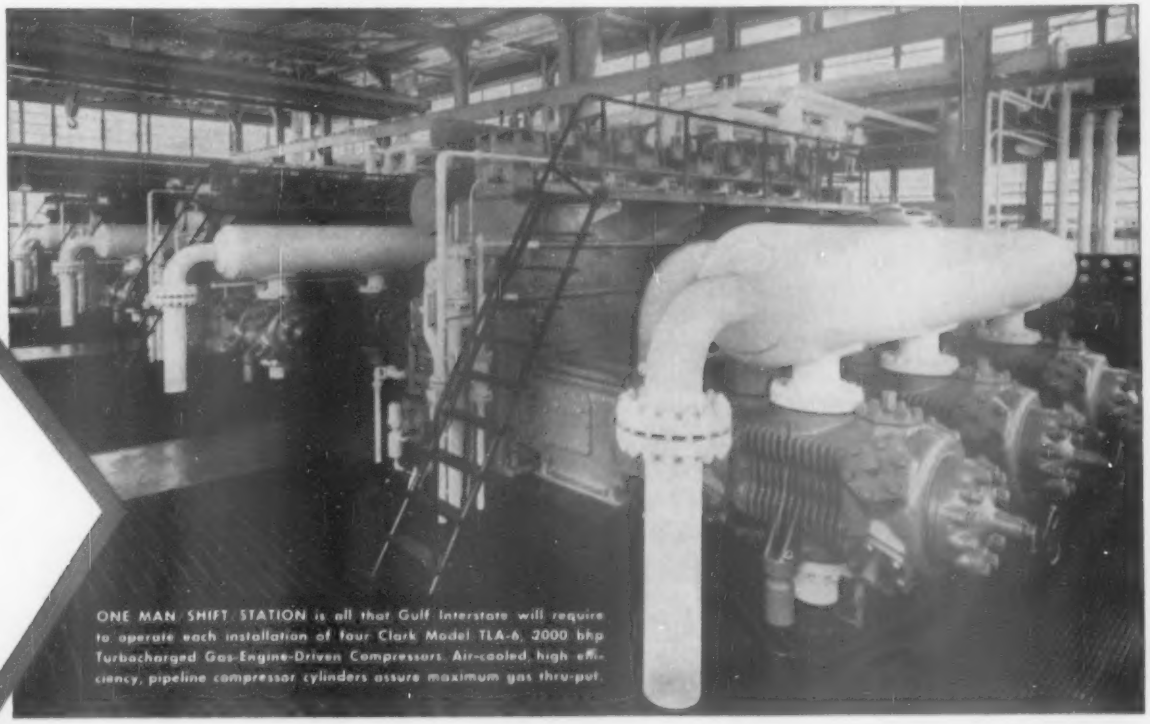
Here's the pattern for gas transmission pipeline compressor stations of the future!

NEW GULF INTERSTATE SYSTEM

Selects the Clark Turbocharged Model TLA-6 for its Automatic, Push-Button Operated Stations



ONE MAN SHIFT STATION is all that Gulf Interstate will require to operate each installation of four Clark Model TLA-6, 2000 bhp Turbocharged Gas-Engine-Driven Compressors. Air-cooled, high efficiency, pipeline compressor cylinders assure maximum gas thru-put.

It's already an accepted fact that the Gulf Interstate Gas Company has changed the pattern for natural gas transmission with its one man, push-button controlled, automatic compressor stations.

With such advanced thinking, it's only natural that Gulf Interstate will be the first to use the NEW Clark Model TLA, 2000 bhp, Turbocharged Compressors in conjunction with their newly developed system of controls.

Gulf Interstate's control devices for automatic operation of these Clark Compressors did not appreciably increase the installed cost.

If you're interested in a compressor station that can be operated with the highest possible efficiency — *automatically* — while still maintaining station-loading flexibility, be sure you investigate Clark Models TRA and TLA Compressors. There are 8 sizes in a range of 825-3300 bhp. Ask your nearest Clark representative for Bulletins 130 and 134.

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- 25-30% lower installation cost.
- Drastic reduction in number of moving parts.
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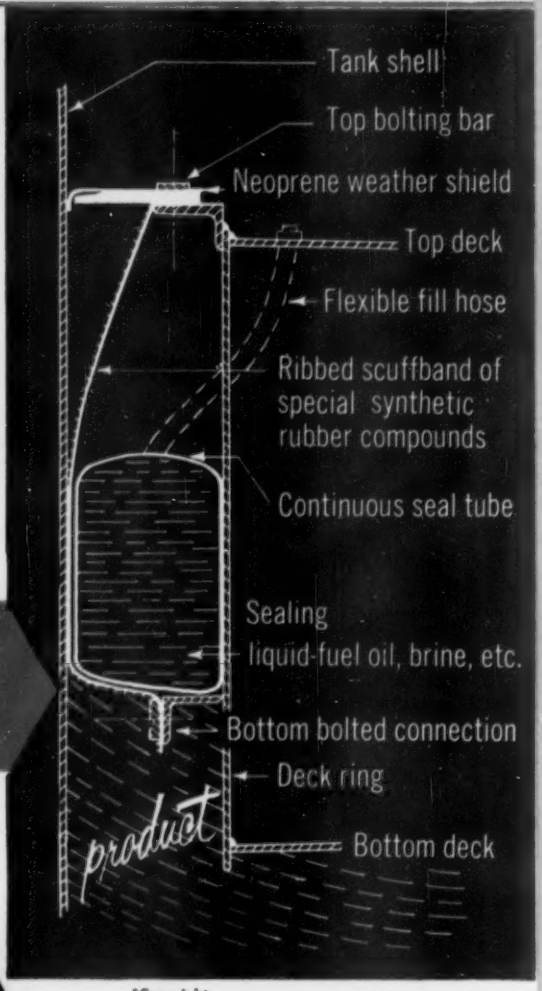
- Low cycle temperatures for maximum cylinder and ring life.
- Only one turbocharger per unit.
- Unapproached for accessibility.
- 2-cycle simplicity, dependability.

CLARK compressors

Clark sets the pace in compressor progress

Think of what this means to operators of FLOATING ROOF TANKS!

Elimination of potential vapor-loss and preservation of product quality, the most important reasons for a floating roof tank, are now reality . . . the **HAMMOND TUBESEAL,*** for floating roof tanks of welded or riveted construction, provides the most efficient and positive seal known . . . sealed at a point to prevent vapor space between roof, rim and shell, thus there is no room for vapors to form or for the product to come in contact with outside influences and be contaminated . . . the **TUBESEAL*** has no moving parts, requires no maintenance, adjusts for tank out-of-roundness, is climate proof and non-corrodible, can operate to bottom of tank or above the top . . . **ITS ENTIRE CIRCUMFERENCE IS TIGHTLY SEALED UNDER PRESSURE AT ALL TIMES . . . NO VAPOR SPACE BELOW THE SEAL.**



THERE'S NO ROOM FOR VAPORS TO FORM WITH THE HAMMOND TUBESEAL

THE **HAMMOND TUBESEAL*** HAS BEEN THOROUGHLY TESTED IN COMMERCIAL USE . . . IT IS **GUARANTEED** TO YOUR SATISFACTION.

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meeting, Sheraton-Broeck Hotel, Niagara Falls, Ont.

5-9 Oil and Gas Power Division, American Society of Mechanical Engineers, 27th annual conference and engineering exhibit, Hotel Statler, Washington, D. C.

6-10 American Petroleum Institute, Division of Production, midyear committee conference, Brown Palace Hotel, Denver.

6-15 Fourth World Petroleum Congress, Rome, Italy.

7-9 National Oil Scouts and Landmen's Association, 32nd annual meeting, Banff Springs Hotel, Banff, Alberta, Canada.

9-10 Natural Gas and Petroleum Association of Canada, Royal Connaught Hotel, Hamilton, Ont.

9-10 Pennsylvania Grade Crude Oil Association, annual meeting, Hotel William Penn, Pittsburgh.

11-15 Petroleum Equipment Suppliers Association, annual meeting, Banff Springs Hotel, Banff, Alberta, Canada.

12-17 Society of Automotive Engineers, golden anniversary summer meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

16-18 Interstate Oil Compact Commission, Cosmopolitan Hotel, Denver.

17 Northern California Section, American Institute of Chemical Engineers, symposium on waste disposal, University of California, Berkeley, Calif.

20-23 American Society of Mechanical Engineers, semiannual meeting, Statler Hotel, Boston.

23-24 Western Petroleum Refiners Association, technical-industrial relations meeting, Broadview Hotel, Wichita, Kans.

23-26 Rocky Mountain Oil Show, Casper, Wyo.

26-July 1 American Society for Testing Materials, Chalfonte-Hadden Hall, Atlantic City, N. J.

JULY

20-22 Instituto Tecnologico y de Estudios Superiores de Monterrey, first annual short course on instrumentation for industry, campus, Monterrey, N. L., Mexico.

AUGUST

15-17 Society of Automotive Engineers, golden anniversary West Coast meeting, Hotel Multnomah, Portland, Ore.

29-31 15th annual Appalachian Gas Measurement Short Course, West Virginia University, Morgantown, W. Va.

SEPTEMBER

11-13 Independent Natural Gas Association of America, annual meeting, Jasper Park Lodge, Jasper Park, Jasper, Alberta, Canada.

12-14 American Institute of Electrical Engineers, electrical conference of the petroleum industry, Shamrock Hotel, Houston.

13-24 First International Instrument Congress and Exposition, and ninth National Instrument Conference and Exhibit, Philadelphia.

14-16 National Petroleum Association, 53rd annual meeting, Traymore Hotel, Atlantic City, N. J.

22-23 Western Petroleum Refiners Association, regional technical-industrial relations meeting, Hotel Henning, Casper, Wyo.

22-23 Louisiana - Arkansas Division, Mid-Continent Oil and Gas Association, annual membership meeting, Roosevelt Hotel, New Orleans.

26-28 American Association of Oilwell Drilling Contractors, fifteenth annual meeting, Rice Hotel, Houston.

who is this guy?

This is the man who makes the fabulous Southwestern petroleum industry tick! Whether he's doing a rough and rugged job in the field . . or whether he has come up through the ranks to the presidency of his company . . he's a sort of composite spirit of the men who drill for and produce oil and gas.

Joe Roughneck is the No. 1 boy in the great Mid-Continent region where 75 per cent of the nation's crude oil is produced. To help him do a better job, Lone Star's completely integrated steel mill was built right in the middle of Joe's workshop, and today, Lone Star is turning out API casing, tubing and line pipe for his special convenience in getting the job done!

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In a YEAR AND A HALF

Welex Formation Fracturing Tool has Boosted Production in More Than 500 Wells . . .

Read these typical case histories

THE TOOL THAT FIRES AROUND A CORNER

WEST TEXAS

A Spraberry Trend well was completed with bullets in two zones – upper Spraberry sand (6,663′ to 6,667′) and lower Spraberry sand (7,524′ to 7,540′) in September, 1952. Lower sand would not break down at 5,000 p.s.i. after another bullet perforating job and finally jet perforations. Well completed in upper zone, but by mid-1954, dropped to 63 barrels per day. Lower sand was perforated at 7,534′ with *one* shot of the Welex Formation Fracturing Tool, in September, 1954. Formation then broke down at 4,750 p.s.i. and was treated with a 4,500 sand frac job at 3,650 p.s.i. *Well flowed 295 barrels of oil per day and is holding that production.*

OKLAHOMA

A well was drilled in the S. W. Mt. Vernon Pool in Lincoln County in June, 1954, and was a dry hole. Bullet perforating (48 shots) was attempted with no results. Well was abandoned. Re-entered in August, cleaned out below casing, and squeezed off perforations. Well shot twice with Welex Formation Fracturing Tool at 3,385′ and 3,395′. Well was not treated. *After tubing was run, well flowed 32⅝ barrels in two hours and is now testing at 116 barrels per day.*

GULF COAST

A well in the Palo Blanco field had been perforated with no results. Five shots were fired from the Welex Formation Fracturing Tool between 4,745′ and 4,805′ before fracturing with 900 pounds of sand and 240 gallons of jelled oil. Prior to these shots and treatment, well tested 5 barrels per day. *It is now pumping 99.60 barrels per day.* In the same field, Welex shot two of a group of seven wells. Before using the Tool, the wells' averages were 55 and 63 barrels. *After the shots, each well is now making 145 barrels per day.*

Call on Welex . . . the developer of the Formation Fracturing Tool and jet perforating . . . before your next fracturing job. Their experience on more than 500 wells with this remarkable new tool will insure that your job will be better!

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The OIL AND GAS JOURNAL

TULSA, OKLAHOMA

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JOURNALLY SPEAKING...

Gas Issue

OUR gas issue deals with the gas issue. That may be a pun, but it's far from funny.

It's too bad, in a way, that this special Natural Gas Issue of the Journal doesn't go to several hundred thousand gas consumers—and their mayors and congressmen—instead of being confined to people in the oil and gas business.

The lead piece about gas girding to fend off federal control contains a lot of mighty good dope to explain why gas producers are desperately trying to convince Congress that their prices should not be frozen and fixed by the Federal Power Commission.

Most of our readers, we assume, already know all this, so this article is subject to the criticism leveled at so much of the industry's public-relations efforts: "We're talking to ourselves."

Just the same, it's good to review the situation. And you can use some of these facts and figures in discussing the problem with people who aren't yet convinced that gas production is a private, local business with no aspects of a public utility.

Here's a picture of an industry which has grown very rapidly because of an exceptionally brisk demand for its product. The demand was brisk because the price was relatively cheap. The price was cheap because there was too much supply available for a while. But the growing demand caused purchasers to bid up prices.

Anything strange about that situation? Isn't that pretty much the pattern of any commodity? With anything else, supply and demand would soon come into something of a balance, and a top limit on prices would be established by competition with substitute commodities.

But not with gas. The reason is the injection of another factor—politics. It has become politically fashionable to claim that consumers must be protected against an increase in the price of gas. Except for the wartime price controls, we challenge anybody to name a single commodity that has its top price fixed by the federal Government to protect consumers against the workings of supply and demand.

Why should gas production be singled out for special persecution by Uncle Sam? That's the gas issue.

Supply-Demand Map

THE wall map inserted in every copy of this issue of the Journal is labeled "Natural-Gas Pipeline Systems," but it might well have been labeled "Natural-Gas Supply and Demand Map."

The big pink splotches show the principal areas of gas production, the little red dots show the points of consumption, and the network of fine lines shows the hundreds of thousands of miles of pipeline needed to bring supply to demand.

Not many years ago the gas map didn't look anything like it does today. Then, for the most part, pipelines served only areas close to production, and great sections of the country got no natural gas at all.

Our latest map is a pretty good illustration of how supply and demand work together, like one hand washing the other, to the benefit of both, and how they create a huge industry in the process.

Gas was available in some places, wanted in others. Demand kept going up, so producers supplied more gas. But pretty soon all the cheap gas that was lying around waiting for a market was gobbled up. So purchasers began offering producers prices high enough to make it worth spending millions of dollars hunting for more, and that accounts for a lot of the big pink splotches that weren't on the map a few years ago.

You will note that there are many more demand dots than supply splotches. Also that there are a good many cities not yet served with gas, indicating a big potential demand.

Question: Where will the supply come from to fill this new demand?

Answer: By finding new pink splotches to put on the map.

Question: How can the new supplies be found?

Answer: By offering a price high enough to induce people to explore for them.

Question: Will federal control holding down field prices of gas induce people to find new supplies?

Answer: If so, it will be the first time in the history of the world that the laws of supply and demand have been successfully defied.

It's elementary economics.

—Henry D. Ralph.

Blending WARREN natural gasoline with your present high quality motor fuel will give it

RETAINED VOLATILITY!

Like a summer-time gift from Santa...

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EDITORIAL

Here's a new argument for federal control

OPPONENTS of free competition in the gas business are now pressing a new argument in their fight to prevent Congress from freeing producers from federal control.

They are saying that unless the Government intervenes, gas producers will price themselves out of a market—that in the absence of federal ceilings, producers will raise field prices so high that consumers will turn to coal or oil, or go back to using manufactured gas.

It is primarily eastern gas distributors who are advancing this line of reasoning. First they assumed the role of champions of consumers and now they are posing as protectors of the producers.

THIS IS REALLY SOMETHING NEW. Never before has it been suggested that the federal Government, in all its benevolence, should protect producers of a commodity by holding down their prices so that competitors will be discouraged from going after their markets.

Gas men may do some foolish things and perhaps could do with a little advice now and then, but they certainly don't need this kind of paternalism.

Suppose producers do ask such high prices that consumers shy away from their product? That's happened millions of times with every commodity. And every time, prices soon drop back to where consumers resume buying. No federal agency is required to enforce that law.

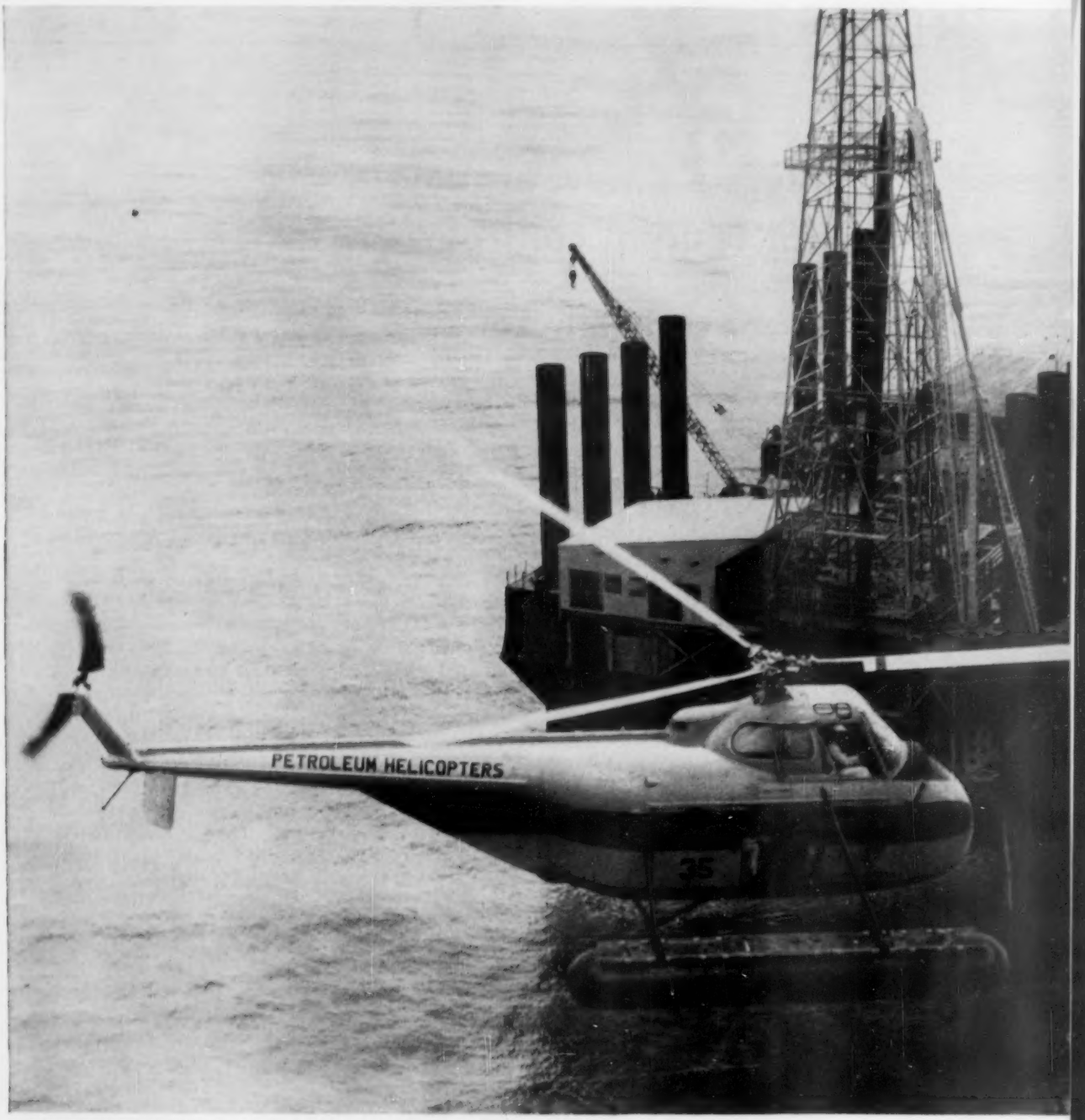
This latest argument for control is really a tacit admission that there is an economic ceiling on gas prices, and that that ceiling is not far above present levels in many market areas. It is an admission that consumers are not at the mercy of a monopoly, and that competing fuels will move in on gas's market if prices rise. It is an argument against the need for price control, rather than for it.

IT'S EASY TO SEE THE DISTRIBUTORS' true position behind their pious front of concern for producers. They stopped manufacturing their own gas and turned to natural because it was so much cheaper that they could undercut competing fuels in their cities without any real competitive effort.

Now if gas prices should go up to the level of competing fuels, these distributors would lose their gravy train. They would have to go out and sell gas competitively. They might even be forced to go back to the bother of operating their own manufactured-gas plants.

So of course they don't want producers to price them (the distributors) into a competitive situation. But it's not the producers' market that they are so concerned about.

The fact that coal and oil may move back in if gas prices go higher is proof that neither consumers nor producers need protection.



A FLOAT-EQUIPPED Sikorsky S-55, owned by Petroleum Helicopters, Inc., flies workmen to a rig offshore.

Fast...Dependable...Efficient...Smooth

Month after month, the many advantages of offshore transportation by float-equipped Sikorsky helicopters are being demonstrated in the Gulf coast drilling operations of major oil companies.

Here big S-55 helicopters regularly provide fast, dependable, efficient and smooth transportation for work crews, specialized personnel or equipment. Even the most distant offshore rigs are only minutes from shore by helicopters, which land aboard tenders or on platforms high above the sea. Sikorskys operate dependably to rigs at sea, on land or marshland.

For detailed facts about these versatile, government-approved aircraft, and information on how they can serve your company efficiently, write today to the General Manager at Sikorsky Aircraft, or telephone him at EDison 4-1071 in Bridgeport, Connecticut.

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DOWELL MAKES NEWS WITH FRAC ACID

New combination acid-fracture treatment produced 1000 BOPD more than oil-base fracturing job

Frac Acid*, a new type of treatment developed by Dowell, is used to fracture and acidize oil and gas wells—in one operation!

Here's an example of its effectiveness. Three wells completed in a limestone formation offset each other. One produced only 90 BOPD after treatment with a total of 40,000 gallons of regular acid. The second well produced 240 BOPD after a 20,000 gallon oil-base fracturing treatment.

Then Dowell engineers fractured the third well using 15,000 gallons of Frac Acid. As a result of this service, the well produced at the rate of 1248 BOPD!

In Frac Acid treatments the fracturing fluid is inhibited hydrochloric acid thickened to carry suspended sand. Chemical additives like those used in regular acidizing may be incorporated as desired. Wells have cleaned up readily after Frac Acid treatments. No gel-breaker solution or shut-in time is required.

See how Frac Acid can help you achieve more successful well completions. Telephone your nearest Dowell office, or write DOWELL INCORPORATED, Tulsa 1, Oklahoma, Dept. E-11.

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services for the oil industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

THIS WEEK . . . . . IN THE NEWS

Refining

• Gulf announces new HDS process for treating residuals. Process uses byproduct hydrogen from cat reformer to remove sulfur and convert substantial amounts of residual feed to distillates.

• Concrete pipe in refinery sewer service is subject to corrosion, even though it carries only "clean" water, A.P.I. Refining Division is told. Esso Standard engineers said they were puzzled by sewer-line leaks. They found bacteria, thriving on hydrogen sulfide released from condenser water, were making sulfuric acid which caused deterioration in the concrete.

• World's largest cat reformer using the Sinclair-Baker catalyst has been contracted for Richfield's Watson, Calif., refinery. Unit will have 17,500 bbl. capacity.

International

• Argentine congress is expected to approve oil concessions to Standard of California. President Peron favors the grants, which would be the first in Argentina in nearly 20 years. His backing apparently will offset the opposition of ultra-nationalistic groups.

• Construction soon will start on the world's highest pipeline, in Bolivia. Tractors working at altitudes of nearly 15,000 ft. are to be equipped with aircraft-type superchargers. Elaborate plans call for batching of crude oil in a products line as output increases to the point where Bolivia can step up its crude exports. Novel plans also call for use of high-pressure crude in a proposed pipeline to power world's first "petroelectric" plant. The line would drop nearly 15,000 ft. in 48 miles.

• A new field is in prospect for Kuwait. A wildcat near the Iraq border reportedly found prolific production in the Burgan sand and is now looking for lighter crude in Zubair formations, which produce across the border in Iraq.

• Western companies may regain prewar oil concessions in Austria under terms of treaty now being negotiated.

Pipelines

• Natural-gas pipeline construction is heading for a record year. Company executives meeting in Pittsburgh estimate money outlay this year will exceed 1954, when 17,500 miles of lines were built.

• Prospects look good for inert-gas-shield welding on pipelines to produce crack-free joints under adverse conditions. Research is continuing to evaluate the weld-metal properties of the process compared with welds made by covered electrodes.

• American Louisiana gets green light from FPC to start construction of a 1,300-mile natural-gas line from Louisiana fields to Michigan.

• Southern Pacific awards first contracts for construction of products pipeline between Los Angeles and El Paso.

• Work will start soon on expansion of Atlantic Seaboard's natural-gas pipeline system in West Virginia, Virginia, and Maryland.

Exploration

• The second recent oil discovery has been made in the Detroit area. The latest, drilled by Pure Oil Co., flowed 174 bbl. of oil in a 4¼-hour test. The well is in Wayne County, 14 miles west of the city limits.

• Eastern Utah has another gas discovery along the Pacific Northwest pipeline route. Kanab Uranium Co. tapped gas in the West Salt Valley area of Grand County. The flow in one test was estimated at 6,000,000 cu. ft. daily.

Natural Gas

• More natural gas will be going into underground storage as transmission companies gear their programs to meet peak demands, to stabilize transmission loads, and to conserve gas. Already there is almost 2 trillion cubic feet of gas in underground storage. About 60 per cent is stored in five states near the big markets.

• Intrastate sales of natural gas may pick up soon. Phillips Petroleum Co. executives last week closed a deal with an Oklahoma electric utility for delivery of a trillion cubic feet over the next 25 years. It was the first major intrastate sales in Oklahoma since the Phillips decision. In Louisiana and Texas, several companies now are dickering for intrastate sales involving gas which normally would go into interstate commerce.

• The FPC will have a hot potato in its lap this week. Lone Star Gas Co. is fighting to keep Natural Gas Pipeline Co. from paying 15 cents per M.c.f. for gas in North Central Texas. Lone Star is offering to build a line from Garvin County, Oklahoma and deliver gas to Natural at a lower price. Lone Star fears a 15-cent price would force it to raise its price over a wide area, passing the boost on to its purchasers.

Natural-Gas Storage Booming

40 companies now are using more than 170 depleted pools for storing excess summer supply for peak winter demands

Capacity now is near 2 trillion cubic feet, and this is expected to grow; it's adding stability to the industry

Paul Swain

NATURAL gas in an underground storage pool is like money in the bank to a gas-transmission or utility company.

These subsurface "banks" have become just about as important to the gas industry as the Federal Reserve system is to the b a n k i n g fraternity. The gas industry banks its gas in low-demand summer months. It then withdraws gas from storage to meet peak demands during the gas-eating frigid months of the winter.

It sounds simple, and it is. But not quite that simple. It is simple enough that the b o o m i n g gas industry has created more and more underground storage with each passing year and it's not through yet.

Gas is now being stored in more than 170 depleted oil or gas fields operated by more than 40 gas companies in 18 states. Others are being prepared for use.

A Journal survey of gas companies shows there are 175 storage projects with a total capacity of 1,598,946,616 M.c.f. (see table).

The American Gas Association recently estimated subsurface storage capacity at 1,859,000,000 M.c.f. in 172 fields. The A.G.A. did not break down the capacity by fields or companies because of a reluctance by some companies to release their storage figures. For these companies, the Journal table provides conservative estimates. These smaller-than-actual figures account for much of the difference between the Journal and A.G.A. figures.

Underground storage for natural gas isn't new, but it's being used far more widely than ever before. The practice actually is more than 40 years old. Since World War II, however, the natural-gas industry has grown so rapidly that such storage has become a necessity for smooth operation.

Underground storage pools serve the industry in three vital ways. They enable the industry to:

. . . **Meet peak demand** requirements of its customers. Often those demands require more gas than transmission lines can deliver under normal operations.

. . . **Stabilize transmission line loads** on a year-round basis. Injecting gas into storage during periods when it is not needed by customers and then tapping storage for the gas during high-demand periods enables transmission companies to operate lines at reasonably steady volumes of throughput. Without storage facilities, natural-gas pipelines would be hard put to serve the needs of gas users in winter. They would be faced also with volumes of gas with no market during the warm summer months. This has been one of the knottiest problems in connection with long-line gas transmission. Storage has helped solve it in many cases.

. . . **Conserve gas** which might otherwise be wasted. This is especially true for gas produced with oil.

Most storage pools are designed to level the peaks and valleys of gas transmission caused by a fluctuating demand. Some, however, have their own peculiar uses and do not conform to the pattern. A few are downright conservation measures. Some are operated as combined cycling and storage projects.

How storage is selected . . . The ideal storage pool is near a major gas consumption area. It would be convenient to transmission lines, also.

A depleted or partially depleted gas reservoir with a closed structure, high permeability, and porosity is made to order for such a project if it also meets the conditions of location.

Fortunately for the gas industry, there are such pools available. Today the major sources of gas supply for the nation are in the Southwest and on the Gulf Coast of Louisiana and Texas. Transmission lines from these prolific gas f i e l d s to the industrial northeast pass through areas of Pennsylvania, West Virginia, Ohio, and New York. These states also once supplied gas markets. The depleted fields in these areas have been grabbed up by the industry and put to use again—this time for storage.

More than 61 per cent of the underground storage capacity for natural gas today is located in the five states of

The Who, Where, and How Much of Underground Gas Storage

Company, field—county—	Capacity in M.c.f.
ARKANSAS	
Arkansas-Oklahoma Gas Co.:	
Lavaca—Sebastian	4,280,000
Shibley—Crawford	1,010,000
CALIFORNIA	
Pacific Lighting Corp.:	
LaGoleta—Santa Barbara	14,400,000
Southern California Gas Co.:	
Playa del Rey—Los Angeles	1,500,000
Newhall-Potrero—Los Angeles	1,000,000
East Whittier—Los Angeles	1,000,000
ILLINOIS	
Mississippi River Fuel Corp.:	
Waterloo—Monroe	12,000,000
Natural Gas Storage Co. of Illinois:	
Herscher—Kankakee	90,000,000
INDIANA	
Indiana Gas & Water Co.:	
Monroe—Monroe	1,500,000
Texas Gas Transmission Corp.:	
Oaktown—Knox	1,068,000
Alford—Pike	3,000,000
KANSAS	
Cities Service Gas Co.:	
Boyer—Butler	986,476
Colony—Anderson	7,937,821
North Welda—Anderson	9,691,648
South Welda—Anderson	11,572,864
McLouth—Jefferson, Leavenworth	11,727,093
Craig—Johnson	6,528,168
Piqua—Allen, Woodson	3,832,677
Consolidated Gas Utilities:	
Collinson—Cowley	1,100,000
Sutcliffe—Neosho	700,000
Eastern Kansas Gas Co.:	
Piqua—Allen, Woodson	3,500,000
Union Gas Systems, Inc.:	
Longton—Chautauqua Elk City—Elk, Montgomery Liberty South—Montgomery Liberty North—Montgomery Buffalo—Wilson Fredonia—Wilson	8,000,000
KENTUCKY	
Central Kentucky Natural Gas Co.:	
Menifee—Menifee	9,000,000
Louisville Gas & Electric Co.:	
Doe Run—Meade	1,500,000
Muldraugh—Meade	900,000
Texas Gas & Transmission Corp.:	
Dixie—Henderson	6,351,000
Hickory—Daviess	1,000,000
MARYLAND	
Washington Gas Light Co.:	
Montgomery	*70,000
MICHIGAN	
Michigan Consolidated Gas Co.:	
Austin—Mecosta	7,400,000
Goodwell—Newaygo	14,500,000
Reed City—Osceola	13,000,000
Lincoln-Freeman—Mecosta	9,100,000
Six Lakes—Mecosta, Montcalm	153,000,000
Michigan Gas Storage Co.:	
Cranberry Lake—Clare	6,726,000
Winterfield—Clare	16,813,000
Riverside—Missaukee	1,500,000
MISSOURI	
Laclede Gas Co.:	
Florissant—St. Louis	120,000,000
MONTANA	
Montana-Dakota Utility Co.:	
Baker—Fallon	50,000,000
NEW MEXICO	
El Paso Natural Gas Co.:	
Rhodes—Lea	65,000,000
Southern Union Gas Co.:	
Keyes—Eddy	1,805,183
Vandargriff—Eddy	3,110,682
Barker-Dakota—San Juan	14,926,961
NEW YORK	
Home Gas Co.:	
Dundee—Schuyler	8,200,000
Gilbert—Allegheny	550,000
Greenwood—Steuben	1,350,000
Colden—Erie	10,000,000
Iroquois Gas Corp.:	
Collins—Erie	1,800,000
Derby—Erie	200,000
Holland—Erie	1,500,000
Quaker—Erie	500,000
Rawlins—Erie	900,000
Zoar—Erie	518,000
E. Aurora—Erie	1,600,000
Bennington—Wyoming	3,500,000
Manufacturers Light & Heat Co.:	
Gilbert—Allegheny	550,000
Dundee—Schuyler	6,150,000
Greenwood—Steuben	325,000
Republic Light, Heat & Power Co.:	
Arkwright—Chatutauqua	400,000
Sheridan—Chautauqua	1,600,000
Sylvania Corp.:	
Tuscarora—Steuben	2,700,000
Iroquois Gas Corp.-Tennessee Gas Transmission Co.:	
Colden	
New York State Nat. Gas Corp.-Tenn. Gas Trans. Co.:	
Harrison	30,700,000
Tennessee Gas Transmission Corp.:	
Ellisburg State Line	
OHIO	
East Ohio Gas Co.:	
Stark-Summitt—Stark-Summitt	49,000,000
Chippewa—Wayne	4,000,000
Columbiana—Columbiana	3,000,000
Natural Gas Co. of West Virginia:	
Lima—Mahoning	2,000,000
Manufacturers Heat & Light Co.:	
Brinker—Columbiana	6,500,000
Ohio Fuel Gas Co.:	
Benton—Hocking	36,700,000
Weaver—Ashland, Richmond	65,000,000
Knox—Knox	3,400,000
Wellington—Lorain, Medina	17,000,000
Pavonia—Ashland	25,000,000
Holmes—Holmes, Wayne	16,700,000
Guernsey—Guernsey, Coshocton	4,700,000
OKLAHOMA	
Oklahoma Natural Gas Co.:	
DePew—Creek	57,000,000
Haskell—Muskogee	10,900,000
Osage—Osage	2,730,000
Panhandle Dolomite—Beckham	89,300,000
Phillips Petroleum Co.:	
Oklahoma City—Oklahoma	225,000
Southwest Natural Gas Co.:	
North Ada—Pontotoc	10,000,000
Consolidated Gas Utilities Corp.:	
Ulan—Pittsburg	13,500,000
PENNSYLVANIA	
Carnegie Natural Gas Co.:	
Bickerton—Allegheny	§130,000
Equitable Gas Co.:	
Bunola—Allegheny	5,128,340
Tepe—Allegheny	1,428,967
Hunters Cave—Greene	3,025,357
Pratt—Greene	4,324,358
Kirby—Greene	2,858,965
Finleyville—Washington	494,713
Swarts—Greene	914,528
Manufacturers Heat & Light Co.:	
Cross Creek—Washington	Being depleted
Donegal—Washington	6,300,000
Heard—Washington, Greene	7,500,000
Holbrook—Washington	1,000,000
Iowa—Jefferson	350,000
Irwin—Westmoreland	500,000

Company, field—county—	Capacity in M.c.f.
Majorsville—Washington, Greene	29,000,000
McKinley—Elk	Being depleted
Munderf—Jefferson	100,000
Rush Run—Westmoreland	Being depleted
New York State Natural Gas Corp.:	
South Bend—Armstrong, Indiana	17,000,000
North Sharon—Potter	5,500,000
East End Tioga—Tioga	32,400,000
Sabinsville—Tioga	32,800,000
Harrison—Potter, Pa.; Steuben, N. Y.	¶32,800,000
N.Y.S.N.G. Corp. and Texas Eastern Transmission Corp.:	
Oakford—Westmoreland	60,000,000
North Penn Gas Co.:	
Farmington—Tioga	4,500,000
Meeker—Tioga	1,500,000
Pennsylvania Gas Co.:	
Ludlow—McKean	409,300
Peoples Natural Gas Co.:	
East McKeesport—Allegheny	Inactive
Gamble-Hayden—Allegheny	2,280,000
Haverline—Allegheny	150,000
Murrysville—Allegheny	2,990,000
Colvin—Washington	2,480,000
Mount Royal—Allegheny	500,000
Truittsburg—Clarion	3,575,000
Patton—Westmoreland	150,000
Webster—Westmoreland	1,140,500
United Natural Gas Co.:	
Belmouth—Elk	450,000
Boone Mt.—Elk	800,000
Bullers—Jefferson	40,000
Galbraith—Jefferson	940,000
Henderson—Mercer-Venago	1,990,000
Markle—Jefferson	100,000
Mohan—Elk	70,000
Queen—Warren-Forrest	175,000
St. Mary's—Elk	180,000
Wellendorf—McKean	265,000
United Natural Gas and Pennsylvania Gas Co.:	
Keelor—McKean	1,400,000
United Natural and Tennessee Gas Transmission Corp.:	
Hebron—Potter	46,300,000
Sylvania Corp.:	
Belmouth	54,000
Keelor	137,300
TEXAS	
Lone Star Gas Co.:	
Cheaney—Eastland	14,500,000
New York City—Clay	4,000,000
WEST VIRGINIA	
Company, field—county—	Capacity in M.c.f.
Equitable Gas Co.:	
Drain—Doddridge	307,639
Skin Creek—Lewis	1,189,771
Comet—Taylor	4,604,160
Maple Lake—Taylor	1,829,018
Logansport—Marion, Wetzel	1,376,127
Hope Natural Gas Co.:	
Newburne—Gilmer	5,000,000
Racket—Gilmer	4,000,000
Fink—Lewis	56,000,000
Pitzer—Marion	1,000,000
Bridgeport—Taylor, Harrison	9,000,000
Crows Run—Wetzel	750,000
Kennedy—Lewis, Harrison	31,000,000
Manufacturers Heat & Light Co.:	
Victory—Marshall, Wetzel	35,000,000
Majorsville—Marshall	(see Pennsylvania)
United Fuel Gas Co.:	
X-1—Putnam	3,800,000
X-2—Kanawha	4,900,000
X-4—Putnam	3,150,000
X-6—Kanawha	5,500,000
X-7—Kanawha	1,500,000
X-8—Kanawha	2,000,000
X-15A—Putnam	1,700,000
X-15B—Kanawha	2,200,000
X-17—Roane	2,800,000
X-19A—Roane	2,400,000
X-19B—Roane	1,700,000
X-49—Putnam	2,000,000
X-52A—Kanawha	26,800,000
X-52B—Kanawha	6,700,000
X-53—Kanawha	50,000
X-54—Kanawha	3,900,000
X-56—Upshur	5,000,000
X-58—Wood, Wirt, Jackson	8,000,000
X-59—Jackson	20,000,000
Godfrey L. Cabot, Inc.:	
Fayetteville—Fayette	13,000
WYOMING	
Montana-Dakota Utilities Co.:	
Billy Creek—Johnson	2,500,000
Elk Basin—Park, Wyo.; Carbon, Mont.	25,000,000
TOTAL	**1,598,946,616**

*Underground high-pressure pipe. †Being developed. ‡Proposed. §Cushion gas only. ¶Presently limited to 10,000,000 M.c.f.

Pennsylvania, West Virginia, New York, Ohio, and Illinois.

Preparing for storage . . . Once surface and mineral rights for an old reservoir have been acquired, one of the major problems is plugging old wells to insure a tight storage pool. In some cases it has been possible to clean out old wells, recondition them, and convert them to injection and withdrawal wells. More often they have to be plugged and new wells drilled.

In addition to the wells themselves, cleaning and dehydration units, measuring equipment, and pipelines linking transmission lines to the storage pool are needed.

In some cases, the storage reservoir can furnish not only a volume of gas, but a concentration of pressure energy as well. If the reservoir pressure can be built up enough during injection, it may deliver gas to the transmission system during withdrawal stages without additional compression for the pipeline.

Oklahoma Natural storage . . . Oklahoma Natural Gas Co., both a producer and a distributor of natural gas, first turned to subsurface storage in 1943 to insure peak demand supplies of gas for Tulsa.

The Osage storage reservoir, on the outskirts of the city, covers 1,920 acres and makes use of the Burgess sand at 1,600 ft. for a storage vault. The pool has a storage capacity of 2,730,000 M.c.f.

The Dutcher sand of the old Depew gas field in Creek County, Oklahoma, was converted by O.N.G. for storage in 1950. The abandoned gas field covers 7,360 acres and is ideally located on the main transmission lines of the company's system. The pool receives gas from Southwest Oklahoma oil fields during the summer injection seasons. It can be used to supply either Tulsa or Oklahoma City gas users during periods of heavy demand.

Departure from pattern . . . One exception to the rule that a gas storage project should be near a ready market is the Rhodes project operated by El Paso Natural Gas Co. in southeast Lea County, New Mexico.

El Paso is using this project as much for pure conservation as it is for an "ace-in-the-hole" gas supply. It is the only storage project operated by the company.

The project was unitized in 1944 primarily as a conservation measure to store casing-head gas which otherwise would have been flared. It also acts as a cushion to protect the company with an abundant supply of gas to meet emergency demands.

The project covers 5,480 acres with 33 wells in the unitized area. El Paso Natural uses the Yates sand reservoir at about 3,000 ft. to hold its injected gas. The company has used 11 of the wells for injection and has put more than 38,000,000 M.c.f. of gas into the reservoir since the operation began. Shut-in pressures have increased from 300 to 500 psi. El Paso Natural plans to inject another 27,000,000 M.c.f. into the reservoir.

The company concedes efficiency of the storage area is not definitely known but says early indications have more

than proved the worth of the project as a conservation measure alone.

Another exception . . . The operation of Houston Pipe Line Co. in Bammel field of Harris County, Texas, is an even more novel exception to the general storage book of rules.

The pipeline firm delivers to operators of the field near Houston up to 15,000 M.c.f. of gas daily. The gas is used by the field operators for cycling purposes. Then, on days of peak heating demands in the city of Houston, the pipeline company has the right to withdraw up to 150,000 M.c.f. daily to serve its customers.

The pipeline company has supplied one-third more gas than it has withdrawn each year since the injection was started. As a result, the bottom-hole pressure of the field has increased, and both the pipeline firm and the field operators have benefitted from the operation.

New T.G.T. system . . . Tennessee Gas Transmission Co. looks to home heating as its biggest avenue for continued expansion. Because of the seasonal nature of this market for gas, T.G.T. is leaning heavily on massive underground storage projects to make this kind of expansion possible.

Underground storage fields—five of them—are the key to the 1,000-mile T.G.T. pipeline loop system that will take the company into the metropolitan New York markets by the next winter season. Gas is now being injected into Hebron field in northern Pennsylvania. The Federal Power Commission has approved use of Colden field in New York and Harrison field, which straddles the New York-Pennsylvania line, for the same purpose. T.G.T. also has obtained tentative FPC approval for similar use of State Line and Ellisburg fields, both on or near the state boundary.

The five fields will give T.G.T. a total capacity of 77,000,000 M.c.f. of gas in storage.

Hebron, the largest and most essential to the project, will have a capacity of 46,300,000 M.c.f. of gas. The field covers about 3,500 acres and when completed may have as many as 70 wells. T.G.T. expects the Hebron field to be comparable to a virgin gas field with almost half its capacity ready for tapping—at 2,000 psi. wellhead pressure—whenever it is needed.

The field is located almost in the center of the looping project which will be completed this year before the heating season. Compressor stations at three locations on this 1,000-mile loop are equipped with double manifolding to move the gas in either direction in the line.

MID-CONTINENT

Novel Gas Deal Signed

Oklahoma electric utility bypasses transmission industry to get big gas supply; pipeline, gasoline plant planned

TULSA.—Public Service Co. of Oklahoma has bypassed the gas-transmission industry and gone direct to the producers in lining up a long-term fuel supply for its large Tulsa generating plant.

The Oklahoma electric-utility company last week announced it has contracted to buy more than a trillion cubic feet of natural gas from Phillips Petroleum Co. and Magnolia Petroleum Co. The gas, from the Springer Trend area in southern Oklahoma, will be delivered over a 25-year period. Initial price is 12 cents per M.c.f., with upward adjustments later.

There were several unusual aspects to the arrangement. Here are some of them:

. . . Public Service Co. and the producing companies will have no financial interest in a 140-mile, 24-in. line which will move the gas to Tulsa. The line will be built by a new firm, Transok Pipe Line Co., headed by Tulsa Attorney John M. Winters, Jr.

. . . An escalator clause provides for an increase in price to 18 cents an M.c.f. within a few years. Later, it is understood, the price may be changed to conform to the "going field price" in the area as determined by independent investigators.

. . . Reserve checks will be made periodically by independent evaluators. If it should develop there is insufficient gas remaining in the area to provide the full 25-year supply, Phillips and Magnolia are obligated to obtain additional supplies and deliver the gas to the pipeline.

. . . It is the first big intrastate deal in Oklahoma since the Phillips decision. K. S. Adams, chairman, and Paul Endacott, president of Phillips, said much of the gas was originally destined for an interstate pipeline before the 1954 Supreme Court decision subjecting the company to Federal Power Commission control. "We anticipate further acceleration of markets for natural gas within the state in which it is produced in preference to federally regulated interstate markets," the Phillips executives said.

The unusual gas-purchase deal was undertaken because of Public Service Co.'s need to obtain a long-term gas supply at a known price. It is understood that the company had been unable to obtain a long-term commitment from Oklahoma Natural Gas Co.

The pipeline . . . Construction is scheduled to begin this month on the 140-mile line, and on the gathering system in the Bradley, West Lindsay, and Northwest Purdy areas. Pipe Line Service Co., Seminole, Okla., will lay the line. Pipe is being supplied by Bovaird Supply Co., Oakley Engineering Co., Tulsa, is handling the engineering, and right-of-way was acquired by Coates Field Service, Inc., Oklahoma City.

Officers of Transok include Roger S. Randolph and Horace D. Ballaine, both law partners of Winters, vice presidents; C. C. Killin, vice president, secretary, and assistant treasurer; J. R. Ryan, assistant secretary, and P. H. Kuper, comptroller.

Gasoline plant planned . . . Along with the gas-purchase and pipeline announcements, it was disclosed that Phillips and Magnolia jointly will build a gasoline plant 3 miles west of Lindsay in Garvin County.

The plant will extract liquids from the gas produced in the Northwest Purdy, West Lindsay, and Bradley area pools. Phillips will be operator of the plant.

Phillips and Magnolia will operate the gathering lines and compressor facilities in the fields and will deliver the dry gas to the Transok line at a pressure of 700 psi. The gas-purchase arrangement provides options under which the supply and transmission contracts may be extended 5 years.

NPC Backs Import Cut

Voluntary control plan supported as answer to keeping fair balance between imports and domestic production

Bertram F. Linz

WASHINGTON.—Voluntary restriction of oil imports, backed by the threat of forcible action from the Government, received strong support at the spring meeting of the National Petroleum Council.

An NPC committee, after exhaustive study, reported that fair and equitable relationships should obtain at all times between imports of crude and products and total domestic demand. The cabinet fuels committee's recommendations for voluntary control are "worthy of careful study," it said.

Interior Secretary Douglas McKay, addressing the NPC, pointed out he was a member of the cabinet committee and declared he firmly supported its views. He urged the industry to comply with its recommendations. He warned that if voluntary action fails, the consequences will be serious.

The cabinet committee's recommendations have been written into the Reciprocal Trade Act by the Senate. It gave the President authority to adopt quotas or such other measures as he felt necessary, if imports reach a point where the Office of Defense Mobilization feels they threaten national security. Administration officials have promised this authority will be used if voluntary restriction fails.

Switch in fuels . . . In its report, the NPC committee answered charges by the coal industry that imports were the basic cause of the narrowing coal market. Important changes in the fuel economy, not the result of imports, also are taking place, the committee said. It cited increased use of natural gas and railroad conversion to diesel engines among those changes.

The committee found that imports of residual fuel oil have operated largely to fill the gap between high demand and lower domestic supplies, resulting from refiners' efforts to reduce the yield of residual. But crude oil imports have not been attracted by any lack of domestic productive capacity. Instead of supplementing domestic supplies, these imports have reduced the income and rate of return on production operations.

The effect will be to slow down domestic exploration, drilling and development. The committee noted that while domestic productive capacity has increased more rapidly than domestic demand since 1949 the growth in proved reserves has been slower than the rise in demand.

"Circumstances existing through 1954 have not thus far kept domestic exploration and drilling from increasing," the report said. "Even so, proved domestic reserves have not kept pace with the growth of demand. To the extent that imports exceed the level needed to supplement our domestic supplies and operate to retard domestic exploration and development, they have an influence contrary to the nation's economic welfare and security."

The committee reached three definite conclusions:

. . . **"The continued increase** in imports of crude oil coupled with a decline in exports of crude oil and its products has damaged in varying degrees segments of the domestic oil industry.

. . . **"Further increases of imports** without regard to the principle of only supplementing the domestic production of crude oil and its products will seriously damage the domestic oil industry and thus affect the domestic economy.

. . . **"Fair and equitable relationships** have not prevailed between total imports of crude oil and total demands for oil in the United States during periods of excess availability of domestic oil for U. S. consumption."

The NPC now is making a study of tank truck transportation. To round out the picture, it will make a survey of the industry's manpower, requested by the Office of Oil and Gas. The new study, to bring up to date a 1951 survey, will include estimates of manpower as of next July 1 in both the petroleum and gas branches, classified by functional divisions, occupations, skills and geographical areas.

Labor Decision Reversed

WASHINGTON.—A National Labor Board ruling that a collective bargaining contract expires when it is reopened for wage negotiations has been knocked out by a decision of the Eighth Circuit Court of Appeals.

The court ruling, in effect, writes a "no strike" clause into every contract.

The NLBR awarded back pay to employes of the Lion Oil Co., El Dorado, Ark., who struck while negotiations were under way under a wage-reopening clause in a contract still in effect. The union had given 60 days notice, as required by the act, and also 60 days notice of its desire to reopen the contract for wage negotiations. It failed, however, to give the further 60 days notice required by the contract if either party wanted to terminate it.

The board held that the contract expired when it was reopened. The court ruled a bargaining contract remained in effect until it expires or is terminated by notice or other action provided in the agreement. It held that the strike was illegal and refused to enforce the board's back-pay award.

Senate Passes Oil Compact

WASHINGTON.—A 4-year extension of the Interstate Oil Compact was voted by the Senate last week.

But the Senate added a provision long pressed by some members of Congress. It will require the attorney general to make an annual report as to whether the states have been using the compact to fix prices, promote monopoly, or regiment the production or sale of oil or gas.

The extension bill would continue the Compact, now due to expire next September 1, to September 1, 1959.

The Senate also passed a bill barring the federal Government from acquiring the mineral interests in lands purchased by it except when necessary to serve the purpose for which the lands are taken. The bill is designed to protect landowners who may not be aware they can reserve the mineral rights when selling most lands to the government.

Oil-Shale Plans Revised

WASHINGTON.—The Interior Department planned to quit its oil-shale research work this summer. Then the roof fell in.

It actually happened. The roof of the department's shale mine collapsed. Now the department wants to find out how it happened. And how to keep it from happening again.

The Government's work on oil from shale has reached the point where industry is ready to take over. But the mining of shale is an important part of the operation. Department officials see problems not met in coal or mineral mining.

Gas Fight Waxes Hot

Price-control arguments in Congress take sectional flavor; House committee votes FPC control over escalation clauses

WASHINGTON. — Controversy over exempting independent natural-gas producers from federal-price control is running hot on both sides of the capitol.

The Senate interstate commerce committee this week is in the midst of hearings on the matter. Acting Chairman Pastore of Rhode Island said the group will make a "comprehensive" study of all phases of the gas situation.

The House interstate commerce committee is trying to write a bill exempting producers, transfer burden of price regulation from them to pipeline companies, and meet demands of consumer spokesmen for "protection."

First agreement reached by the House committee was that the Federal Power Commission should be given authority to pass on escalation clauses. The committee reportedly agreed by a 17-4 vote to allow FPC to control contract provisions calling for specified increases at fixed periods.

Committee Chairman Priest said the group is going over the Harris bill, section by section. He hopes to have a compromise measure ready to send to the House floor before the end of this month.

The Senate group heard supporters of exemption last week. Now it is hearing objectors. Its hearings are expected to run to the end of the month.

At opening of the hearings, Senator Fulbright of Arkansas made a strong appeal for the bill he has introduced. This is the Harris bill, rounded out with recommendations made by the pipeline industry.

Fulbright declared natural gas is the issue in a fight between the North and the South. Northern states, he charged, have for a century attempted to exploit economic resources of the South without regard to the effect upon that area.

The Arkansas senator said in their efforts to get a "luxury" fuel at a low price, the consuming states are trying to buy "a Cadillac at a Ford price." He said there should be no controls whatever on gas prices, but added he was offering to give the FPC authority over prices to be paid by pipeline companies as a "compromise."

Pastore refused to accept Fulbright's argument. He said the issue is not whether there should be any regulation, but how far regulation should go. The only question in which he is interested, he said, is protection of consumers against skyrocketing gas prices.

Fulbright put blame for high consumer rates on local distributors. The increase in wellhead prices between 1938 and 1953 was less than loss in the value of the dollar, he declared. That alone is evidence that competitive forces have been effective in keeping producer prices down.

Fulbright said the Supreme Court made a "monumental error" in deciding the Phillips case. That decision substitutes federal control for competition and will repress expansion of the gas industry. It puts the FPC is a position to dictate to the states, overriding their conservation efforts. And if federal control is upheld on gas, he warned, it will be impossible to prevent its ultimate extension to oil, with which much of the gas is produced.

The industry's presentation was largely a repetition of the testimony given before the House committee in March. The major argument was made through Lt. Gen. Ernest O. Thompson of the Texas Railroad Commission; David T. Searls, Houston attorney; and John W. Boatwright of Standard Oil Co. (Ind.). The producers' views were presented through J. P. Jones of Bradford, Pa.; Clarence T. Smith of Flora, Ill.; and Richard G. Lawton of Magnolia, Ark.

H. B. Fell of Ardmore, Okla., an independent producer and former executive vice president of the Independent Petroleum Association of America, testified in favor of the bill as spokesman for the U. S. Chamber of Commerce.

Producers reminded the committee they have already had experience with government price-fixing.

They recalled that the wartime Office of Price Administration regulated prices so sharply that the oil industry was almost stifled. They told the committee they wanted no more of it, and argued there is no reason to single out gas for regulation while leaving oil, coal, steel and other basic commodities free. They warned that the consumer, in the long run, will suffer rather than benefit from price control at the source.

Federal Leasing Change Made

WASHINGTON. — Assignments of royalty interests in federal oil and gas leases must be filed with the the Bureau of Land Management.

The Interior Department has issued a regulation requiring the filing. However, the regulation said filing is merely for record purposes. The bureau will not give formal approval of assignments. Assignments will be accepted as valid if accompanied by a statement over the assignee's signature that he is a U. S. citizen and that his interests in oil and gas leases do not exceed the acreage limitations.

The new regulation is based on a finding that royalty interests in oil and gas leases constitute holdings or control of lands and deposits under Section 27 of the Mineral Leasing Act.

Nation's Biggest Ammonia Storage Facilities

Lion Oil Co. claims the largest anhydrous storage facilities in the United States at its El Dorado, Ark., petrochemical plant. The company has 14 spherical tanks at El Dorado, with the largest capable of holding 1,500 tons of ammonia. At its Luling, La., plant, Lion has four spherical tanks. The capacity at the two plants is in excess of 20,000 tons. Lion has a daily ammonia producing capacity of about 950 tons.

Gas Line Approved

American Louisiana wins long fight for FPC permit

WASHINGTON.—American Louisiana Pipe Line Co. was given the go-ahead on its Louisiana-Michigan natural-gas line by the Federal Power Commission last week.

The FPC issued sales certificates to four producers who will furnish gas for the line. Its action ended a 7-month delay which started last October 1 when American Louisiana was given a construction certificate but forbidden to start building until its suppliers were approved.

The four producers are Superior Oil Co.; Kerr-McGee Oil Industries, Inc.; Stanolind Oil & Gas Co.; and British-American Oil Producing Co. Two other companies which agreed tentatively last year to supply the line pulled out when the FPC started its producer regulation.

Hearings were held on the producers' applications last month. In its decision the FPC said they had shown that their gas, together with gas to be supplied by Texas Gas Transmission Corp., would give American Louisiana sufficient reserves to meet the requirements of its certificate.

The 1,300-mile pipeline will run from North Tepetate, La., to Bridgman and Detroit, Mich. It will include 1,172 miles of 30-in. line to Detroit and 117 miles of 22-in. line from near Payne, Ohio, to the Bridgman area. Cost will be $130,700,000 and initial capacity will be approximately 300,000 M.c.f. daily *(The Oil and Gas Journal, March 14, page 85)*.

To supply the line, Texas Gas Transmission will build 48 miles of pipeline paralleling sections of its existing system between its Lake Cormarant, Miss., and Slaughter, Ky., stations. The line will cost $4,281,135. The company will furnish an average of 51,000 M.c.f. of gas daily to American Louisiana.

Little Inch Switch Opposed

WASHINGTON.—Mississippi River barge operators asked the Federal Power Commission last week to review an examiner's recommendation that Texas Eastern Transmission Corp. be allowed to convert the Little Inch pipeline from natural gas to oil products.

The operators charge "hostility" on the part of the presiding examiner which denied them fair opportunity to present their opposition to the conversion.

The switch of the pipeline is being fought by River Co., Inc.; Chotin Towing Corp.; and Greenville Towing Co.

WATCHING WASHINGTON

Bertram F. Linz

Oil Legislation Behind

Congress is more than halfway through its 1955 session. But it is considerably less than halfway through its program of legislation affecting the oil and gas industry.

Final action has been taken only on disposition of the Government's synthetic-rubber plants and extension of the emergency-tax rates on corporate income and the excise items. Extension of the Reciprocal Trade Act is nearing the White House. A House committee has finished hearings on the exemption of independent natural-gas producers from federal price regulation, and a Senate committee is just starting them. The Senate has approved continuance of the interstate oil compact. And that about winds up the progress to date.

Extension of the Defense Production Act, probably with provision for standby price and wage controls, is definitely set to come up. Interior Department officials are still hopeful of a favorable opportunity to lay their plan to open 20,000,000-odd acres of reserved Alaskan lands for oil exploration and development before congressional committees. Beyond that the crystal ball is cloudy.

It is now unlikely that any drive will be made to change the depletion allowance for oil and gas. An increase in the minimum wage is being studied in committee, but a fight is building up which may kill its chances of passage. Revision of the Taft-Hartley Labor Relations Act appears to be definitely ruled out for the year, as does any major new antitrust legislation. A nation-wide investigation of the air pollution problem was planned but doesn't seem likely to get anywhere.

After the elections last year which gave the Democrats control of Congress it was expected there would be a rash of investigations. A number of probes have been started, but none of them hit the oil and gas industry.

Jet Fuel Growing Up

Jet fuel has become the big item in military oil requirements.

It will represent 38 per cent of all the oil to be bought by the Armed Services Petroleum Purchasing Agency during the fiscal year which begins July 1. This year it will amount to 31 per cent of the total.

Total military oil demand during fiscal 1956 now is placed at 245,000,000 bbl. That will be an increase of 20,000,000 bbl. over the total for the current year. But the jet fuel requirement will jump more than 23,000,000 bbl. ASPPA estimates it will be around 93,000,000 bbl. against slightly less than 70,000,000 bbl. this year.

The aviation gasoline need will be the same as for this year, proportionately. ASPPA estimates it at 20 per cent of the total, which would be 49,000,000 bbl. against 45,000,000.

The major reductions in demand will be in motor gasoline and Navy special fuel oil. Most other products, including lubricants and greases, will show only small changes.

Labor Eyes '56 Campaign

Politics may become a matter of more than personal interest to oil men in the next few years.

The merged AFL-CIO is going to be a big factor in the political situation. Top labor leaders have said the new organization will go into politics in a big way. They see little chance of influencing the Republican party. But they do see a good chance to dominate the Democratic party and will work actively in the 1956 campaigns. That may mean a Democratic Congress elected next year even if President Eisenhower runs for reelection and wins.

The new Oil, Chemical and Atomic Workers Union will be among the larger groups in the AFL-CIO organization. If labor's hand-picked candidates are elected they will be responsive to any legislative demands the oil workers may make.

It won't be smart to write off organized labor as a political influence. The CIO practically took over Michigan in the last election, putting the candidates it supported into office without difficulty.

The unions have a lot of money to spend on politics. And they can spend it without the restrictions that keep down other contributors, such as corporations. It's an open secret that some labor leaders believe they can dominate the Democratic party in 1960. They would not be surprised if a labor man, Walter Reuther in particular, showed up as a candidate for one of the two highest offices at that year's Democratic convention.

Productive Capacity Up

Domestic availability of crude and gas oils increased 937,000 bbl. daily in 18 months, NPC committee reports

WASHINGTON.—A sharp climb in productive capacity of the nation's oil wells since January 1953 is noted by the National Petroleum Council in a recent survey made at request of the Interior Department.

Domestic availability of all oils rose from 8,159,000 bbl. daily in January 1953 to 9,096,000 bbl. daily in July 1954, according to the NPC's committee on petroleum productive capacity. This amounts to a gain of 937,000 bbl. per day in 18 months.

The committee's study showed that the increase in availability was at a much higher rate during the 18 months covered by the survey than in the preceding 3 years. Capacity rose at an annual rate of 625,000 bbl. daily from January 1953 to July 1954. The annual increase was about 430,000 bbl. daily in 1951-52.

The rapid climb was attributed to technological developments, together with more development drilling. Factors raising capacity, the group pointed out, include pressure maintenance in some new fields, water flooding and gas injection in older fields, and increased use of formation fracturing.

"With favorable economic circumstances and incentives," the committee concluded, "the industry should be able to continue providing the domestic availability so necessary for economic progress and national security."

The committee was headed by L. F. McCollum, president of Continental Oil Co. Its survey was similar to studies made by the NPC in 1951 and 1953.

Biggest gains . . . Greatest gains in productive capacity were in the Southwest and Rocky Mountains. Increased pipeline capacity provided larger market outlets in those regions, the NPC report noted.

The committee pointed out that the rate of increase in availability was more rapid than was the rate of increase in oil-well completions.

In 1951 and 1952, completions at the rate of 23,450 annually offset the decline in capacity of old wells and increased crude-oil availability at an annual rate estimated at 369,000 bbl. daily. In the following 18 months, completions were at a rate of about 26,900 per year. But crude availability rose at an annual rate estimated at 577,000 bbl. daily.

The report covers both crude oil and gas liquids.

In July 1954, the report shows, the nation had a reserve capacity for all petroleum liquids of 2,210,000 bbl. daily. This total represents the difference between availability and production, then at a seasonal low. By January 1955, petroleum demand in the United States rose to 9,301,000 bbl. daily, reflecting a big seasonal change.

The committee's estimates of petroleum availability are shown in the accompanying table. Comparisons are made with previous reports.

U. S. PETROLEUM AVAILABILITY
(Thousands of barrels daily)

	Jan. 1951	Jan. 1953	July 1954
Crude oil:			
East Coast	54	49	43
Mid-Continent	1,083	1,238	1,380
Southwest	4,161	4,686	5,224
Rocky Mountains	350	394	561
California	1,079	1,098	1,123
Total crude	6,727	7,465	8,331
Gas liquids	573	694	765
All oils	7,300	8,159	9,096

CANADA

Big Growth Seen

Demand for crude may be up 70 per cent in 1960

EDMONTON.—A 70 per cent increase during the next 5 years in the market outlet for light and medium Canadian crude oil was predicted last week by Fred G. Cottle, manager of the transportation and supply department of Imperial Oil, Ltd.

Addressing the Canadian Institute of Mining and Metallurgy, Cottle estimated that present outlets for Canadian crude of 335,000 bbl. daily would increase to 573,000 bbl. daily by 1960.

He pointed out that growth of the U. S. market for Canadian oil was an important factor in the increase. In regard to present debates in Washington on import restrictions Cottle expressed optimism that both governments recognized the importance of reciprocal trade in oil.

Summarizing the market possibilities for western crude, Cottle expressed belief that Canadian prairie demand would increase during the next 5 years by 25.2 per cent or from 123,000 bbl. daily to 154,000 bbl. daily. The eastern markets are expected to increase from 129,000 bbl. to 246,000 bbl. daily, a gain of 90 per cent.

On the West Coast, growth within the next 5 years is expected to reach 108.4 per cent from 83,000 bbl. daily to 173,000 bbl. daily. He pointed out that this growth pattern, unlike past performances, does not depend upon the construction of new major transportation projects.

Cottle said that the possibilities of western Canadian crude oil supplying the substantial refinery market in Montreal has been studied intensively and that "the economic problems involved appear to outweigh by a large margin the apparent advantage to Canadian producers."

Arctic Survey Planned

OTTAWA.—Canadian geological teams this summer will survey a vast 120,000-sq.-mile area of the Arctic islands to determine if they hold possibilities for oil or other mineral production.

The project is rated the biggest geological survey of the Canadian North. It will be conducted by the geological survey branch of the Dominion Department of Technical Surveys. Both surface work and airborne-magnetometer surveys are planned.

Dr. L. W. Morley, director of the magnetometer work, said he will particularly study terrain under the channels separating the islands for oil-bearing strata. Geology of the area has been compared both to the Alberta foothills and oil-bearing lands around the Gulf of Mexico.

Refinery Units Completed

KAMLOOPS, B. C.—Royalite Products, Ltd., has gone on stream with three processing units at its 5,000-bbl. refinery here.

The units, all built by Universal Oil Products Co., of Des Plaines, Ill., are a fluid catalytic cracker, a gas-concentration plant, and a polymerization unit. The 1,420-bbl. cat cracker is one of the smallest in the world. It cracks blended atmospheric and vacuum gas oils at a conversion of 65 per cent into high-octane gasoline. The poly unit produces 126 bbl. daily of 10-lb. polymer, plus butane and propane byproducts.

Spotlight on Hydrogen

Interest snowballs at A.P.I. refinery session on uses for this surplus byproduct; Gulf reveals new low-pressure process

George Weber

ST. LOUIS.—The spotlight was on hydrogen treating last week as the American Petroleum Institute's Division of Refining marked its Silver Jubilee here.

With the extensive adoption of catalytic reforming, refiners throughout the country now are making millions of cubic feet of byproduct hydrogen every day.

Interest in new ways to use this hydrogen to improve products is snowballing. This was reflected in eight papers on processing, which concerned both internal refinery and external chemical uses for all the new hydrogen.

One new development is the combined hydrocracking and hydrodesulfurization of whole crudes and residual blends at moderate pressures. Three processes for hydrogen treating of distillates were discussed formally for the first time. Other, established techniques were reviewed, and purification of hydrogen in reformer off-gas was brought up to date.

HDS for residuals . . . Gulf Research & Development Co. took the wraps off its HDS process, opening the field to the treatment of residuals.

This new operation differs from the older, more severe hydrocracking techniques in demanding much lower pressures. Even under the present depressed market for residual fuels, this new technique should show payouts on investment comparable with conventional residual processes, Gulf's Jerry McAfee said. If residual prices depress further, economics will markedly favor the HDS process. *(See page 196 for complete HDS paper.)*

Using hydrogen from cat reforming, the HDS process plays a dual role. It will convert substantial fractions of residual feed stocks to distillates at the same time removing most of the sulfur.

The exact nature of the catalyst or catalysts used in Gulf's development program was not revealed. Research began with nickel oxide for desulfurizing distillates. But when attention turned to residuals, other compound-supported metallic catalysts were substituted since they showed better hydrocracking activity.

These catalysts have proved rugged and stable under the relatively severe conditions imposed on them. They withstand periodic regeneration. They show a unique stability, successfully processing stocks high in vanadium and other heavy metals with only minor losses in activity.

Large-scale pilot-plant tests have revealed some interesting results. Five years' operation of a 50-bbl. unit at Port Arthur refinery was directed mainly at West Texas and Kuwait crudes. Both whole crudes and blends of distillates with vacuum bottoms were processed.

In mild operations with pressures of 500 to 1,000 psi., substantial conversion of residuals to distillate product was accompanied by 80 to 85 per cent desulfurization. More severe conversions showed 90 per cent sulfur reduction with only 3 to 4 per cent yield of bottoms. Hydrogen consumption ranges from 200 to 500 cu. ft. per barrel of whole crude, and 400 to 1,200 for residuals. Hydrogen circulation rates resemble those used in normal catalytic reforming.

Shell vapor phase . . . Another technique with a long development background was discussed by research engineers of Shell Development Co. They presented commercial data on two selective vapor-phase hydrodesulfurization units which have been in operation for 10 years. The Shell process, not to be confused with Royal Dutch-Shell's "Trickle Process," uses a tungsten-nickel-sulfide catalyst.

The two war-built units were designed to desulfurize catalytically cracked naphthas for aviation gasoline stocks. Since the war, one unit—at Wood River, Ill., has been used to treat high sulfur West Texas distillates for fuel oil and mineral spirits. The second unit at Dominguez, Calif., was converted to processing catalytic and thermal naphthas for motor fuel.

Long experience with this catalyst, at pressures above 500 psig. and temperatures below 700° F., has proved it to be selective for removal of sulfur including ring sulfur, without cracking or polymerization, or hydrogenation of aromatics. The most promising applications, said M. D. Abbott in presenting the paper, lie in the field of desulfurizing cracked naphthas containing 0.4 to 1.5 weight per cent sulfur, for motor fuel blending. The low-sulfur, low-gum product shows an increase in leaded motor octane number and only a small decrease in leaded research octane.

Indiana Hydrofining . . . Both desulfurization and improvement of burning quality in distillates from sour crudes are accomplished by a Hydrofining process developed by Standard Oil Co. (Ind.). This process was developed to replace acid treating and solvent extraction which give relatively low yields and do not desulfurize completely.

Using a commercial hydrogenation catalyst and a conventional fixed-bed operation, Indiana Standard ran numerous tests on No. 1 fuel oil from West Texas crudes. Desulfurization was thorough under both mild and severe conditions, said Indiana's W. J. Zimmerschied.

Burning quality was improved by hydrogenating some of the aromatics, which run about 20 per cent in the raw feed stock. Mild Hydrofining reduced these total aromatics to 15 per cent, comparable with Mid-Continent stocks. Severe processing brought them down to 9 per cent, and reduced naphthalenes from 4 to less than 1 per cent. This made a super-quality fuel.

Temperatures range from 550° to 850° F.; pressures from a mild 500 to a severe 3,000 psi. Hydrogen consumption at these pressure ranges will vary from 500 to 3,000 cu. ft. per barrel of feed.

Unifining . . . Commercial data from the growing list of operating Unifiners were reported jointly by authors with Universal Oil Products Co. and Union Oil Co. They presented results obtained from Unifining catalytic reforming feed stocks, thermal and catalytic naphthas, solvent naphthas, straightrun and cracked middle distillates and heavy distillates.

Results were obtained from some of the 10 units in operation. The authors report that 16 additional units now under construction will raise total Unifining capacity to 223,000 bbl. per day.

Houdry Process Corp. reported on hydropretreatment of catalytic reformer feed stock, using a platinum catalyst in the guard chamber designed into the Houdriforming unit. They report almost complete removal of sulfur including thiophenes, from virgin and thermal naphthas and from naphtha-kerosine cuts.

External uses . . . While the trend is more and more toward internal hydro-

gen consumption in a wide variety of product treating processes, these for the most part absorb only a part of total hydrogen produced in a balanced refinery. Virtually the only external end use to date has been for ammonia.

In a paper discussing markets and potential uses for hydrogen, Robert L. James of Arthur D. Little, Inc., recommended caution in planning ammonia units. The recent boom in ammonia plants has already resulted in an excess of capacity. While new manufacturers will enter this field because of the advantages they possess in a ready-made supply of reformer hydrogen, they may find the going rough.

James pointed to a few alternate end uses, none of them very exciting. Minor volumes might find use in hydrogenation of vegetable oils, but a high purity is required. Consumption in the synthesis of organic chemicals looks slim. Metallurgy may take a little hydrogen, for powdered iron reduction, but again the market is a small one.

Some new uses, such as phosphine and coal hydrogenation, may be developed but none appears potentially promising at present, the author said.

Ammonia may be in oversupply now, but its future is strong. In a paper concerning hydrogen recovery and purification from reformer gas, Spaco, Inc., compared fertilizer consumption in this country and abroad. In contrast to the 7 lb. of nitrogen per acre used here in 1951, Netherlands used 132 lb. and other European countries from 12 to 71 lb. per acre.

Traps Devised for Trace Metals

Chemists tell refiners of new, fast methods to detect these catalyst destroyers which must be removed from feed stocks

ST. LOUIS.—Fast and accurate methods for determining trace metals in petroleum fractions are now available, three speakers told refiners here last week. These metals destroy catalysts in certain refining processes, and they must be removed from the feed stocks.

A wet-ash determination will give much better results than the dry-ash method, said J. T. Horeczy of Humble Oil and Refining Co., Baytown, Tex. In the wet-ash technique, a sample of the feed stock is mixed with sulfuric acid and heated to dryness. The remaining ash is then leached with hydrochloric acid.

Recoveries of iron, nickel, vanadium, and copper from the ash are nearly 100 per cent by this method. Results of analyses are thus much more accurate than those obtained using the dry-ash method.

Spectrographic analysis . . . Nickel and vanadium in concentrations of 0.1 to 1,000 p.p.m. in oil feed stocks can be determined rapidly by another new technique, said J. E. McEvoy, Houdry Process Corp., Marcus Hook, Pa.

The stocks are first cracked in the liquid phase on active ground-silica-alumina catalyst. Amounts of the metals deposited on the catalyst are then determined by spectrographic analysis. Total time required is less than 6 hours.

Still another new way to determine concentrations of nickel and vanadium in trace amounts is by an X-ray spectrographic method, said E. N. Davis, Sinclair Research Laboratories, Inc., Harvey, Ill. Method is fast and accurate, and requires only a small sample.

The sample first is ashed and then put into solution. A part of this solution is evaporated on a sample plate and rotated under the X-ray beam. Amounts of the metals present depend on intensities of radiations from the sample.

New nitrogen method . . . A new, fast, inexpensive, and accurate method is now in use for determining traces of combined nitrogen in reformer feedstocks, said R. W. King, Sun Oil Co., Norwood, Pa. The method particularly is suitable for the concentration range, 1 to 100 p.p.pm.

This determination is very important, since even traces of nitrogen in reformer feed can poison the catalyst and reduce gasoline yield.

The sample is vaporized, mixed with hydrogen, and passed over nickel-magnesium catalyst at 350° to 360° C. Nitrogen compounds are decomposed by this treatment, and resulting free nitrogen reacts with hydrogen to form ammonia. Concentration of ammonia is then determined colorimetrically.

Suitability of reformer feed stocks for making aromatics also can now be predicted accurately and rapidly, said C. C. Martin, Sun Oil Co.

The six and seven-carbon naphthas, which are converted to aromatics during reforming, can be determined within 1 per cent. Infrared spectrometry is the best method for determining all the individual compounds. Accurate analysis for total naphthenes can be obtained using relatively simple physical measurements, such as density and refractive index.

A.P.I.–REFINING

Oil Chemists Cited

Merit awards are given to Miller, Baldeschwieler

ST. LOUIS.—Two petroleum scientists whose service in the oil industry totals nearly 75 years have received certificates of appreciation from the American Petroleum Institute's Division of Refining.

They are Albert E. Miller, assistant to Sinclair Refining Co.'s vice president for research and development, and Emile Louis Baldeschwieler, retired lab-

MILLER

BALDESCHWIELER

oratory director of Esso Research & Engineering Co.

Miller was cited for his tireless work on projects of the committee on petroleum products.

Baldeschwieler won recognition for his long efforts to apply analytical chemistry to advancing petroleum technology. His citation paid tribute to his leadership on the committee on analytical research.

Vast Changes Seen

Future refineries will be big chemical plants

ST. LOUIS.—The refining industry is beginning to look more and more like the chemical industry, Chester F. Smith told A.P.I. refiners here last week.

The Standard Oil Co. (N.J.) vice president declared the two industries may one day merge. He added future refineries will have a far more difficult job and probably will bear only a superficial resemblance to those today.

"We will be forced more and more to break up crude oil into small building blocks and reassemble these to form the particular kinds of molecules we want. As we do this, processes such as hydrogenation will become more and more important to us and will let us secure the precise hydrogen saturation we wish in our synthesized molecules.

"If we look at our future refineries as vast chemical plants, it is clear that the type of crude we feed into these plants will become less and less important so long as it contains both carbon and hydrogen."

Labor Problem Eased

Union uses combination of company crews, contract help to meet fluctuating labor requirements in its refineries

G. L. Farrar

ST. LOUIS.—A major refinery problem—having enough competent help for turnarounds without having too big a labor force in between—can be solved by using a combination of fixed company forces, semipermanent contract crews, and temporary contract help.

This is the experience at Union Oil Co. refineries at Los Angeles and Oleum, Calif., John W. Towler of Union, told the A.P.I. refining meeting.

Refiners long have been faced with the problem of providing adequate maintenance forces during time of turnaround, without having excess manpower during normal operations. This problem is further complicated by unexpected work due to failures and by varying nature of jobs required on different units.

Where one unit may require mostly pipefitters to revamp piping, the next unit may require a majority of boilermakers to repair exchangers, furnaces, and towers. Type of work even may change abruptly after a turnaround has begun.

These constantly changing and often unpredictable manpower demands always are superimposed on a relatively constant amount of maintenance to on-stream units.

Union's plan assures a plentiful supply of manpower when and where it is needed.

How it works . . . When no turnaround work is going on, the maintenance force might consist of 275 men—175 employes of Union and 100 contractor employes. The contractor crew helps with normal maintenance work and is a nucleus for expanded turnaround work.

The contractor crew contains the minimum number of men, craft by craft, needed for first-line supervision during maximum manpower needs. The men then act as general foremen and working foremen when the contractor-supplied working force is expanded.

These men are hand-picked for general all-around ability. They know the refinery, its maintenance organization, its operation units, and its procedures.

The company maintenance organization is unchanged by the use of contract help. The contract force is headed by a superintendent who is responsible to the company superintendent of maintenance.

The contract superintendent has the foremen of each craft in his organization report to him. They also are responsible to company foremen for the quality and proper completion of work in their crafts.

Contracts . . . Maintenance contracts are written two ways. One is based on cost plus a percentage for field-office expense, overhead, and profit. The second is based on yearly payroll.

Direct labor rates are negotiated by the general maintenance contractors with local craft and labor unions.

How Esso discovered and licked . . .

. . . Corrosion in Concrete Pipe

ST. LOUIS.—Refiners using concrete pipe for "clean water" sewers would do well to take a look at them. They may be badly corroded above the water line.

It has always been assumed that concrete was corrosionproof for handling condenser water. But Esso Standard Oil Co. has learned differently. Company engineers first suspected trouble when a leak was discovered in a large 1,800-ft. concrete line handling condenser water from a catalytic cracking unit. Cores taken along the line showed that concrete was bady deteriorated, especially along the first 500 to 600 ft. A full inspection during a turnaround of the catalytic cracker verified this.

In a report presented to refiners here last week, John Zahodnick described studies of this unexpected development and outlined measures to combat it.

The consensus of the engineers was that sulfur-oxidizing bacteria had a hand in the trouble. They knew that some hydrogen sulfide was dissolved in the condenser water. This gas, released to the air space above the water, became fixed on the upper pipe surface forming weak acids. These alone will react very slowly with concrete, and are not enough to cause alarm.

But this initial attack forms a corrosion product which promotes growth of bacteria. With all conditions right for their good health, these organisms, known as "Thiobacillus thiooxidans," took over and started making sulfuric acid in earnest. The concrete line deteriorated rapidly from that point on.

The two stages of corrosion are well illustrated in this case. During the first three years of operation, the concrete deteriorated to a depth of only 1/16 in. from the weak acid caused by hydrogen sulfide deposits. But when the bacteria went to work the depth of damage increased to ½ inch by the fourth year, and to 1¾ in. by the end of the fifth.

After considering several measures of repair—all costly—Esso did a relining job on the upper half of the line during a unit turnaround. Engineers first installed a wire mesh anchored with expansion bolt hooks. Over this they gunited a 3-in. layer of acid resistant calcium aluminate cement with a 6-in. overlap on the sound cement below the water line.

Code Change Asked

Cheaper pressure vessels for refineries now possible

ST. LOUIS.—Pressure vessels for refinery use may be built more economically and just as safely if needed revisions are made to the A.S.M.E. code.

New and better materials and more precise methods of design and fabrication justify relaxation of some provisions.

For these reasons, C. R. Soderberg, Jr., M. W. Kellogg Co., New York, outlined detailed proposed chances to the code here last week for refiners. He proposed pressure vessels made of ferrous materials be classified into three groups—C, G, and N.

Class C vessels would be used for critical service. They would have no restrictions as to pressure, temperature, and stored contents. High external loadings and stress ranges would be permitted.

Class G vessels would be used for general service. They would have some restrictions as to pressure, temperature, and service. External loadings and stress ranges would be somewhat lower.

Class N vessels would be used for nonhazardous services. Rather rigid restrictions would be placed on temperature, pressure, contents, external loadings, and stress ranges. However, the design and fabrication requirements would be greatly relaxed.

Pipelining at New Peak

Natural-gas projects setting record; A.G.A. delegates also told of new pipeline building and operating techniques

Paul Reed

PITTSBURGH. — Executives of natural-gas companies estimate they will spend a record amount this year on pipeline construction, another year of tremendous growth in the industry.

The leaders made their estimates in informal discussions here last week while attending the supply, transmission, and storage sectional meetings of the American Gas Association.

Exact figures were not revealed on cost of construction now hitting top speed over the country. But executives said the work will exceed that done in 1954. Last year the industry added 17,500 miles of new gathering, transmission, and distribution lines. Plans were announced for more than 11,000 miles of natural-gas transmission lines earlier this year. These did not include many new gathering or distribution lines planned.

The construction is part of a 3-year, $2 billion expansion program being undertaken by the industry. When completed the new projects will bring gas to every section of the nation *(The Oil and Gas Journal, January 4, 1954, page 49)*.

The annual gathering attracted 497 industry representatives. Reports and technical papers featured such industry problems as gas turbines, 36-in. pipeline construction, and research.

J. L. Thompson, Michigan-Wisconsin Pipe Line Co., chairman of the A.G.A. pipeline research committee, revealed the association's research budget now totaled $309,000. This included $242,500 for continuing projects already under way and $66,500 for new undertakings.

Welding experiments . . . Researchers at Battelle Memorial Institute reported on investigations made into pipeline welding. These studies primarily concerned base metal cracking in the heat affected zones near girth welds and welded connections in grade X-52 pipe.

Study of these cracks is important. The breaks serve as notches which can start failures. The experiments revealed amount of base-metal cracking in welded girth joints:

. . . Increased rapidly as the carbon and manganese contents of the pipe approached maximum specified for grade X-52 pipe.

. . . Increased with lowered welding temperatures.

. . . Decreased by preheat and by immediate application of the hot pass.

Research work will continue on the inert-gas-shielded process with these objectives:

. . . Demonstrate the process produces crack-free joints under adverse conditions.

. . . Evaluate the weld-metal properties of the process compared with those of welds made with covered electrodes.

Turbines gain . . . The gas men also heard that gas turbines now may be expected to operate 3 or 4 years between major overhauls.

J. S. Quill, General Electric Co., declared the rapid advance of this pipeline tool is shown by new turbine installations. He said centrifugal units totaling 270,000 hp. have been installed in the last 3 years. Of these, units totaling 210,000 hp. were ordered by pipeline compressor stations in this country and 60,000 hp. units went to Creole Petroleum Corp.'s repressuring plants in Venezuela.

Quill said efficiency of turbine units has been improved from 25 to 28½ per cent while average horsepower has gone from 5,000 to 7,600.

Costs of gas-turbine stations so far installed with 5,700-hp. units have ranged from $175 to $250 per horsepower. Stations with 6,700 and 7,600-hp. units, projected for the near future, will average less.

Quill revealed the possibilities of engine-driven centrifugal compressors will be demonstrated at two installations—Gulf Interstate Gas Co. and Transcontinental Gas Pipe Line Corp. These will pioneer a new technique which promises advantages for units of 2,500 hp. and above.

Big-inch practices . . . Raymond H. Crowe of Transcontinental Gas Pipe Line Corp. said only one contractor has started off using the sewer-pipe method of laying the firm's 36-in. diameter loop project. Others are employing conventional over-the-ditch practices.

Crowe added the problem of bridging in, backfilling, and consequent settling is expected to be less with the wider ditch used for the sewer-pipe method.

He explained work already done on the line indicated no trouble will be experienced with bending the yard-coated pipe or with lineup.

Other pipeline developments reported included:

. . . Detergent-water method is quickest and most effective for internal cleaning of pipelines. Clinton McClure, El Paso Natural Gas Co. said his firm saved $48,260 in 1954 with the process, while allowing 49,000,000 cu. ft. of gas daily to be transmitted during cleanout.

. . . Cathodic protection and inhibitors correct most corrosion troubles in compressor unit operations. J. C. Berringer, Panhandle Eastern Pipe Line Co., explained magnesium ribbon has been used for reducing metal loss in power piston rods.

SPEAKERS at the compressor station technical session of the American Gas Association conference in Pittsburgh shown above are left to right, A. R. A. Markl, Tube Turns, Louisville, Ky.; S. A. Bradfield, Southern California Natural Gas Co., San Gabriel, Calif.; Newel C. Comfort, Hope Natural Gas Co., Clarksburg, W. Va.; Joseph S. Quill, General Electric Co., Schenectady, N. Y.; and David Salls, Cooper-Bessemer Corp., Mount Vernon, Ohio.

Oil Needs to Soar

Royal Dutch-Shell Group predicts energy requirements to double by 1980; growth anticipated in oil industry

NEW YORK.—World energy requirements will rise at an average rate of 3 per cent a year over the next quarter century with the result that present needs will be doubled by around 1980.

This forecast—called a conservative estimate—was given last week in the annual report of the Royal Dutch-Shell Group as illustrative of the future growth that can be anticipated in the petroleum industry. Oil will be called on to make an increasing contribution to energy requirements, with fuel oil in particular demand outside the United States.

Last year, world production amounted to nearly 5,250,000,000 bbl. (about 14,350,000 bbl daily). This, the reports pointed out, was 5 per cent more than in 1953. Consumption, though up only 2 per cent in the United States, showed another sharp rise of about 10 per cent outside this country.

The parallel reports and accompanying review of activities of the two parent group companies—Royal Dutch Petroleum Co., holding 60 per cent, and Shell Transport & Trading Co., Ltd., holding 40 per cent—ranged over a number of subjects dealing not only with company operations but also general industry trends.

Finances . . . Capital expenditures of this world-wide organization last year amounted to 226 million pounds (about $725,000,000), as compared with 220 million pounds in 1953. Of this, 110 million pounds, or slightly less than 50 per cent, was in exploration and production. Another 57 million pounds was in manufacturing, and 28 million pounds in marketing. Ocean-going fleets took 27 million pounds, and the remaining 4 million was for miscellaneous facilities.

Commenting on these outlays, the companies said a considerable proportion of the sum arises from the increasing demands for the construction of refineries in the areas of consumption.

"Without going into the arguments for or against this trend—which vary widely owing to the differing circumstances of one country as compared with another—it is desirable to point out that a refinery must have a certain minimum capacity if it is to produce the high quality of products increasingly in demand; below this minimum the building of a refinery cannot economically be justified," said the Royal Dutch report.

"Self sufficiency, however appealing it may be from the point of view of national prestige, can in certain circumstances only be at the expense of flexibility and the continuing need for future capital investment to replace and modernize equipment."

The reports also stressed that capital expenditures will continue to increase and that much of the outlay should be charged as "defensive," that is as a cost of maintaining the business rather than new investment on which added return can be anticipated.

Price study blasted . . . In a section dealing with the recent report of the Economic Commission for Europe on oil pricing, the companies said total profits of the major oil companies, including Royal Dutch-Shell, represent large sums in terms of money. But, they said, last year's net income of the group represented a return on capital employed of less than 14 per cent. On the 32 billlion gallons (U.S.) of oil sold, the profit margin from all operations—producing, shipping, manufacturing, and marketing—was about 1 1/5 cents a gallon.

"It is a curious fact that the authors of the E.C.E. document, seeking knowledge as they obviously were, seem to have neglected the annual reports of the oil industry," said Royal Dutch company.

"The same must apply to many of the other critics who could not have seriously raised some of the questions which they did if they had taken the trouble to acquaint themselves with the information contained in the annual reports of Royal Dutch."

Production . . . Production of the entire group last year averaged around 1,400,000 bbl. daily, 5½ per cent higher than in the previous year. Including special supply contracts, total supplies of crude amounted to nearly 1,800,000 bbl. daily.

Refinery throughput of group companies was equivalent to a daily average of more than 1,800,000 bbl., up nearly 9 per cent from 1953.

At the end of the year, tonnage of vessels of more than 2,000 tons operated by group companies amounted to about 7,100,000 tons. Vessels owned by the group represented about one-third of the tonnage. The others were chartered.

Wage Demands Hinted

Union group representing Texaco workers recommends new pay program be presented to oil industry by October

DENVER.—The C.I.O.'s Oil, Chemical and Atomic Workers International Union may approach the oil industry with new wage demands this fall.

A hint of such action emerged from a meeting here of the O.C.A.W. nationwide council which bargains for the Texas Co. union members.

The council recommended that no immediate action be taken on a general wage increase, but that the union's bargaining policy committee be urged to submit a new wage program to the whole oil industry not later than October 1.

The 100,000 oil-industry workers in O.C.A.W. were granted a general wage increase averaging 10 cents an hour early in March.

The union president, O. A. (Jack) Knight, said then that he felt the workers were getting "a wage increase in 1955 which was due in 1954. . . .

Controversial clauses . . . Among the major oil companies, only the Sinclair Oil Corp. contract—largest in the industry—remains to be negotiated.

O.C.A.W. terminated that agreement early in April after members agreed to accept a 10-cent across-the-board raise but held out for improvements in the sick-benefits plan and group life-insurance program.

The Texas Co. union council, headed by Len Yarborough of Tulsa, also recommended that bargaining groups adopt, as a guide in future negotiations for all contracts, a hospital-insurance plan under which the company would pay 50 per cent of the costs.

Other contract benefits will be demanded from Texaco, and possibly the rest of the industry as well. They include improvement and expansion of the employe-savings plan, full pay for all time lost due to industrial accidents, longer vacations, improved provisions regarding life insurance for retiring employes, an additional paid holiday, protection against revision of job changes without union agreement, previ-

sion against contracting maintenance and repair work to outsiders, and establishment of a standard Monday-through-Friday work week.

Detroit Well Hits

First Niagaran production found by Pure Oil's test

DETROIT.—The greater Detroit area has another oil discovery.

Pure Oil Co.'s 1 Crowe-Fraser Consolidated in Wayne County about 14 miles west of the city limits flowed 174 bbl. of oil in 4¼ hours on a drill-stem test at 3,091-3,102 ft. Another test made at 3,120-42 ft. indicates possibilities of oil production.

The discovery is the first oil strike made in the Niagaran (Silurian) limestone near the city. Other producing wells in the Northville area produce from the Trenton lime, a deeper Ordovician pay.

Pure has about 2,000 acres in the vicinity of the well under lease.

Detroit is one of three one-million-plus cities in the U.S. with oil production in or near the city limits. Recently an oil well was completed on city property inside the Detroit city limits. Houston and Los Angeles are the other major cities with important production.

Cycling-Plant Job Let

TULSA.—Sunray Mid-Continent Oil Co. has awarded Tuloma Builders, Inc., of Tulsa, the contract for a new cycling plant in Acadia Parish, Louisiana.

The plant, which will have a capacity of 27,000,000 cu. ft. of natural gas daily, will be located in Northwest Branch field, 1 mile northwest of Branch, La. The field, discovered by the former Sunray Oil Corp. in 1951, now has eight producing wells and one being drilled. Construction will be completed this fall.

Co-ops Boost Output

Report shows their refineries increased runs in 1954, sales jumped while oil production dropped, well holdings rose

WASHINGTON.—Petroleum cooperatives produced less oil last year than in 1953. But they added to their well holdings. Their refinery output was greater and they marketed more products.

The co-ops are not a big segment of the oil industry. But in many parts of the corn belt and wheat country they are the largest distributor of oil products to farmers.

Statistically, the 22 oil co-ops have a working interest in 0.6 per cent of the nation's oil wells, a survey by the Cooperative League showed. They produced about 0.2 per cent of the domestic crude oil last year. Their 17 refineries represent only 5.6 per cent of the total number of plants and their capacity is only 1.8 per cent of the total rated output. They made 2.4 per cent of the country's products in 1954.

At the close of 1954 the co-ops had working interests in 2,927 wells, the survey showed. That was an increase of 503 for the year. Net crude production was 5,216,752 bbl., down 310,751 bbl. for the year. Refinery capacity was 157,350 bbl., a drop of 1,850 bbl. from 1953. Average daily crude throughput, however, was 142,200 bbl., an increase of 6,735 bbl. Refined production was 50,619,932 bbl., an increase of 6,942,207 bbl.

Last year the co-ops marketed 40,009,114 bbl. of fuels, against 39,093,319 bbl. in 1953; 15,400,875 gal. of lube oils against 15,185,623, and 17,161,807 pounds of greases against 17,564,651 pounds.

The league survey pointed out that the co-ops refineries turned out 38.1 per cent more barrels of refined fuels last year than the 14 regional co-ops that own them distributed. Some of the excess production was sold to other regional co-ops. *(The Oil and Gas Journal, February 7, page 70).*

At the start of the year, co-ops owned 1,890 miles of crude-oil gathering lines and two major refined-fuel pipelines. One runs from McPherson, Kan., to two Omaha area terminals and the other diagonally across Indiana. They also own river and lake terminals, river barges, highway transport trucks, railroad tank cars and other petroleum transportation equipment.

What Co-ops Did in 1954

	Production		Refining	
	Wells in which co-op had working interest	Net prod., bbl.	Cap., bbl. daily	Avg. daily throughput, bbl.
Consumers Cooperative Assn.	1,505	1,951,777		
Coffeyville, Kans.			24,000	22,298
Phillipsburg, Kans			4,200	5,442
Scottsbluff, Neb.			2,200	1,772
Newcastle, Wyo.			Sold	457
Farm Bureau Cooperative Assn.	25	216,000	6,000	5,520
Farmers Petroleum Cooperative	173	133,491		
Farmers Union Central Exchange	33	491,026		
Laurel, Mont.			12,500	13,542
Illinois Farm Supply Co., Pana, Ill.			6,000	3,894
Indiana Farm Bureau Cooperative Assn.	329	443,833		
Mount Vernon, Ind.			10,000	9,111
MFA Oil Co.	70	36,200		
Chanute, Kans.			2,000	1,800
Memphis, Tenn.			6,000	5,750
Midland Cooperatives	138	135,643		
Cushing, Okla.			11,000	8,412
National Cooperative Refinery Assn.	637	1,779,171		
McPherson, Kans.			24,000	21,708
Pacific Supply Cooperative	17	29,611		
Premier Refining Co.:				
Longview, Tex.			4,500	3,200
Arp, Tex.			5,000	
Fort Worth, Tex.			8,000	9,400
Baird, Tex.			2,600	2,000
Texas City Refining Co., Texas City			30,000	27,000
Utah Co-op Assn., Jensen, Utah			1,200	822
Totals	2,927	5,216,752	157,350	142,200

DRILLING CONTRACTORS exchange ideas at A.A.O.D.C.'s annual drilling safety clinic at Baker Hotel in Dallas. Welcoming attendees is J. V. Dunbar, president of association and of Dunbar Drilling Co., Denver. Others at speakers' table (from left) are: W. W. Duncan, Loffland Brothers Co., Tulsa; John S. Jackson, Rowan Drilling Co., Inc., Fort Worth; and R. J. Moran, Moran Drilling Co., Wichita Falls, Tex.

Rig Safety Possible

Keeping experienced men on job is good insurance against accidents, panel concludes at A.A.O.D.C. safety meeting

Robert J. Enright

DALLAS.—A drilling contractor can hire a good safety director, work out a good safety program, delegate safety responsibility all the way down the line—and still have a sorry safety record.

This was brought out during a panel discussion at the tenth annual drilling safety clinic of the American Association of Oilwell Drilling Contractors in Dallas.

The panel was composed of two safety directors, two tool pushers, two drillers, and a roughneck. Moderator was J. W. Baldwin of Humble Oil & Refining Co., Midland, Tex.

A big turnover in drillers and roughnecks is the reason this situation can, and often does, come about. Inexperience is the biggest contributor to rig accidents, the panel agreed. Those contractors and rig-operating oil companies who habitually work the most new hands are also habitually plagued with the most lost-time accidents.

The rig owner needs more than just a good safety program, according to the panel. He needs to offer benefits which will make his older hands want to stay with him. These would include:

...Job promotions to those employes who are deserving of them.

...A retirement plan of some sort.

...An intensive effort to keep his crew busy, or at least to split up the work evenly among the crews.

Baldwin said oil-company drilling departments seem to have made more headway in keeping hands than have contractors. Part of his job, he said, was to interview applicants for drilling-crew jobs with Humble.

One of the questions always asked, he said, was why the job-seeker left his former job (almost always with a contractor). Most answers to this question in one-two order were lack of promotions and lack of security.

The job applicants, he said, meant more than being covered by compensation insurance when they talked of security on the job. By security they meant assurance that they would get to work a reasonable portion of the year, that the company was helping provide for their old age, that they were working under conditions as safe as possible, or a combination of these.

Steady work . . . Keeping an experienced man on a job which requires that he be forever moving around the country is a tough problem at best. It is doubly difficult if an able man feels he has little chance of promotion or if he thinks he might be working only half the time.

Providing steady work is one of the rig owner's stiffest headaches, Baldwin said. The problem probably can't be conquered completely, but with effort it can certainly be minimized, he said.

A representative from one contracting firm said from the audience that his company tried hard when one of its rigs was down to farm out its idle crew temporarily to active rigs in the area.

Another said his company worked each crew member only 5 days a week, thus keeping more men busy. Such a system, he said, cuts down a man's monthly salary to some extent but increases his yearly wage.

Kentucky May Have Boom

GREENVILLE, Ky. — Southwestern Kentucky will soon know whether a mild oil boom now going on will develop into major proportions.

Four counties, Christian, Todd, Muhlenberg, and Butler, have been the scenes of shallow discoveries in the Tar Springs, Hardinsburg, Cypress, Bethel, and McClosky horizons. Some of the wells are producing more than 100 bbl. daily.

Milton S. Yunker, independent operator from Owensboro, Ky., has announced plans to drill 15 wildcats on blocks in the counties. He will be joined by Felmont Oil Corp., Basin Drilling Co., Marhill Oil & Gas Co., all of Owensboro, and Jack Anton, Plymouth, Wis., and Richard Dooley, Chicago.

Southern Pacific Jobs Let

LOS ANGELES. — First contracts have been awarded for Southern Pacific Pipe Line, Inc.'s 800-mile products line from Los Angeles to El Paso.

Management Engineers, Inc., the Bechtel Corp. subsidiary in charge of engineering and constructing the line, has awarded work on the section from El Paso to Tucson. Morrison-Knudsen Co., Inc., Los Angeles, and River Construction Co., Fort Worth, will lay about a 180-mile section between El Paso and Lordsburg, N. M. The remaining 150 miles into Tucson will be laid by R. H. Fulton Co., Lubbock, Tex.

Gas Pipeline Approved

CHARLESTON, W. Va. — Atlantic Seaboard Corp., Charleston, will begin construction soon on 84 miles of pipeline and 2,000 hp. additional compressor capacity on its natural-gas system in West Virginia, Virginia, and Maryland.

The company has received Federal Power Commission authority for the $9,281,500 job. The 26-in. line will parallel various sections of the existing line between Cobb, W. Va., and Baltimore.

160 Townlot Wells

Huntington Beach pool may have 200 producers soon

LOS ANGELES. — The number of producers completed in the townlot pool on the southeast edge of Huntington Beach has passed the 160 mark. Indications are that more than 200 wells will be completed in the 4,000-ft. pool, which extends over an area of only some 50 acres.

Per-well production continues to decline, reflecting the extremely close well spacing being used. At the first of the month 157 wells were producing 11,247 bbl. daily, an average of 72 bbl. per well per day. The month previous per-well average, with 98 wells completed, was 100 bbl. daily. At the first of March it was 165 bbl.

The number of rigs being used in the area has declined slightly. Only about 35 are drilling now compared with 45 at the first of April. There probably will be a larger drop during May.

Meanwhile, state lease bids on a 320-acre tract offshore from the townlot activity will be opened June 8. Because of the upland leases they control, Standard Oil Co. of California and Signal Oil & Gas Co. will be in a more favorable position to develop the area by slant-drilling.

How much of the underwater area will prove productive still must be determined. Indications are the pay may not extend far. Standard has completed one well along the Pacific Electric right-of-way which divides the developed townlot area from the beach. Reported initial production was 28 bbl. daily from a plugged-back depth of 4,100 ft.

Long Beach Loses Again

LONG BEACH.—The city of Long Beach lost two more rounds to the state in its battle to keep funds accruing from oil properties in the Long Beach Harbor area.

An assembly committee approved the Allen bill which will, if passed by the legislature, give the state some $165,000,000 in accumulated tidelands oil funds and route all future oil income into the state treasury.

The second blow was the state Supreme Court's refusal to rehear the Mallon suit, a test of whether the city could spend these funds for upland civic improvements. It had ruled in April that the city is entitled only to sufficient revenue to maintain, improve, and operate its harbor.

The litigation is expected eventually to reach the federal Supreme Court after the legislative battle.

Offshore Ruling Expected

SACRAMENTO.—Decision on the legality of the "filled land" drilling island Richfield Oil Corp. plans to use in developing a lease off Rincon field may be handed down this week.

H. B. Mallon has asked the state Supreme Court to review a Third District Court of Appeals decision. The lower court ruled in March that the "filled land" islands need not be connected with the mainland. It refused to rehear the suit, which was instituted immediately after Richfield was awarded the 1,175-acre state lease.

The Supreme Court is expected to act on Mallon's petition within 10 days after receiving Richfield's reply. Richfield filed its reply May 9. Should the court rule in favor of Richfield, the company will be free to proceed with the proposed island.

Richfield plans to construct the 100 by 120-ft. island in 42 ft. of water. From it about 100 wells could be slanted. Cost of the island is estimated at $2,500,000.

Deep Test Abandoned

LOS ANGELES.—General Petroleum Corp. abandoned its deep wildcat on the west edge of Piru in Santa Clara Valley after reaching a depth of 16,075 ft. At that depth the well, 1 Edwards, had more than 15,000 ft. of open hole, a record for California and probably for the entire industry. Only casing in the hole was 1,044 ft. of 13⅜-in. pipe.

The wildcat was spudded January 18. It was drilled to its total depth without mishap, despite the large amount of open hole. Contractor was Pike Drilling Co., Los Angeles.

Huge Reformer Contracted

LOS ANGELES. — Richfield Oil Corp. has awarded the construction contract for a 17,000-bbl. Sinclair-Baker catalytic reforming unit to Ralph M. Parsons Co.

The unit, to be the largest ever built and the first on the West Coast, will be in Richfield's Watson, Calif., refinery. Work will begin in August and will be completed in mid-1956.

Industry Briefs

TULSA.—Sunray Oil Corp. and Mid-Continent Petroleum Corp. will do business as a single unit in the future. Stockholders of both companies last week approved a merger of the firms. Sunray Mid-Continent Oil Co. will be the new corporate name. A wholly owned subsidiary, D-X Sunray Oil Co., will be organized to operate pipelines, refineries, and conduct widespread D-X service stations, dealer, and marketing functions.

BILLINGS, Mont.—Carter Oil Co. has let contract for a new 6,900-bbl. Hydrofiner and a 2,500-bbl. catalytic reformer at its refinery here. Fluor Corp. won the contract. Carter officials said the new units will improve quality and increase output of motor and diesel fuels.

CASPER, Wyo. — Two Casper oil firms, Illinois Wyoming Oil Co. and Canada Southern Oils, Inc., have merged. Both are wholly owned subsidiaries of Canada Southern Petroleum, Ltd.

SANTA MARIA, Calif.—Last units at Union Oil Co.'s new 18,700-bbl. coking plant 12 miles northwest of here have been placed in operation. The plant processes low-gravity Santa Maria Valley type crudes to obtain a naphtha distillate, gas oil, and coke. The first two products are tankered to the company's Oleum refinery for further processing. About 15 or 20 per cent of the charge is recovered as coke. About 45 tons of sulfur is produced in a new sulfur recovery plant.

WILLISTON, N. D.—North Dakota now has 500 producing oil wells. Last week Amerada Petroleum Corp. completed 2 Volkmann in Charlson field, McKenzie County, to give the state its 500th oil well since the Beaver Lodge discovery in April 1951. Beaver Lodge field, the state's first and biggest, has 198 wells. Tioga runs a close second with 181.

DALLAS.—The American Associa-tion of Oilwell Drilling Contractors in the next 2 weeks will award $400 honorariums to six professors in five universities for outstanding work in encouraging men to make a career of the drilling industry. The honorariums will be presented at the Universities of Tulsa and Kansas, May 16; the University of Southern California, May 24; University of New Mexico, May 26; and Texas Technological College, May 27.

Price Hike Protested

Texas producer tries to head off new pipeline by selling gas below the rate offered by big transmission company

Robert J. Enright

DALLAS.—Lone Star Gas Co. goes before the Federal Power Commission May 16 in the latest round of a new game called "Who's going to sell gas to Natural Gas Pipeline Co. of America."

Lone Star wants to do it and will shower the commissioners with justifying facts and figures this week.

Natural Gas Pipeline is short on gas and getting shorter. A company official said recently that the company's own production—about 177,000,000 cu. ft. daily this year, mostly in the Panhandle—is declining at an annual rate of about 5 per cent.

The company, according to F. P. Burns, assistant vice president, will lack about 80,000,000 cu. ft. daily this year and 240,000,000 cu. ft. daily in 1974 of filling total gas needs for its Chicago market area.

Natural Gas Pipeline has been looking for new supplies. Earlier this year the company applied to FPC for a permit to build a 350-mile line from Fritch in the Texas Panhandle (Hutchinson County) on its system to tap gas reserves in Jack and Wise counties in North Texas.

Witnesses for Natural Gas Pipeline testified at the ensuing hearing that estimated reserves in this area are 2.25 trillion cubic feet, with 0.7 trillion under contract to the company. The major portion of these committed reserves was developed by a group of Texas independents, including Christie, Mitchell & Mitchell, Houston, and Miles Production Co., Dallas.

Terms of the purchase contracts called for payment to producers of 15 cents per M.c.f.

Lone Star steps in . . . Jack and Wise counties are in a general area where Lone Star Gas Co. has long been by far the largest and sometimes the only purchaser.

Natural Gas Pipeline's invasion of this territory and its offer of a relatively high 15 cents brought Lone Star in in a hurry.

Lone Star protested that its opponent's offer was more than 50 per cent higher than the average price now being paid in the area.

If the Natural Gas Pipeline project is approved, company officials testified, Lone Star would have to meet the price, not only in Jack and Wise counties, but all over its system. To assure its future gas supply, this would cost the company more than $10,000,000 annually which would have to be passed on to its 7,000,000 customers in Texas and Oklahoma.

As an alternative, Lone Star offered to build a line from Cotton County, Oklahoma, to Fritch to supply Natural Gas Pipeline. This project would cost an estimated $18,000,000, or about $10,500,000 less than the proposed line from North Texas.

Through the 230-mile line from Oklahoma, Lone Star would deliver gas to Fritch for 20½ cents per M.c.f. North Texas gas would cost 32 or 33 cents per M.c.f. delivered at Fritch, according to Lone Star officials.

The gas which Lone Star would supply actually would come from the Garvin County area of Oklahoma. Lone Star says it has sufficient spare capacity to handle it in existing lines between Garvin and Cotton counties.

West Texas line . . . Together with the Cotton County-Fritch line, Lone Star plans to lay another of about 205 miles from Snyder, in West Texas, to hook up about 60 miles east of Fritch with the artery from Cotton County. Together these two lines would supply Natural Gas Pipeline or others with roughly 200,000,000 cu. ft. a day to start.

Lone Star has surplus gas under contract in the area surrounding Snyder. Intensive drilling in this area has developed more gas than Lone Star can market.

Producers aren't content to sell just a little bit of production it cost them a lot to develop, and they are inclined to chafe under such circumstances. Selling some of this gas to Natural would be one way out.

Lone Star at this week's hearing, however, is expected to ask only for a permit on the Cotton County-Fritch project and hint that it will apply for the other later in the summer.

Opposition girds . . . All this, of course, isn't making the producers in Jack and Wise counties happy. They've sounded off about it already and will make a lot more noise, in company with Natural Gas Pipeline, this week.

Ellison Miles, president of Miles Production, recently called on Lone Star to withdraw its opposition to the Natural Gas Pipeline project.

Lone Star, he said, has been paying the same low price for gas in the area for a long time. The higher price called for in the Natural Gas contracts, he said, is due to 50 per cent higher costs of drilling wells in Wise and Jack counties.

Many independents have abandoned gas wells in the area without attempting to complete them because of current low prices, Miles said.

L.P.G. Flood Set

Phillips is authorized to begin Spraberry project

MIDLAND, Tex. — Phillips Petroleum Co. has the go-ahead from the Texas Railroad Commission to experiment with L.P.G. injection in the Spraberry Trend Area field.

The test will be carried out on Phillip's 320-acre Greathouse "D" lease in the Pembroke area of the big field *(The Oil and Gas Journal, April 18, page 106)*.

Butane for injection will be supplied from the company's natural-gasoline plant in Benedum field to the south. It will be delivered direct to the injection well from the plant by a pipeline, part of which must be laid.

The pilot operation would be on a five-spot pattern with the input well in the center except that in this case one of the four producing locations has not been drilled. The injection rate probably will fluctuate with the market for butane. At present about 600 bbl. daily is available for injection.

The company expects the butane to act as a solvent and leach the crude out of the tight Spraberry matrix. A company spokesman said Phillips believes it can recover 90 per cent of Spraberry oil in place.

West Texas Properties Sold

DALLAS. — Producing Properties, Inc., Dallas, has purchased 13 wells producing a daily allowable of 1,591 bbl. in Reinecke pool of Borden County, West Texas. The properties were purchased from J. D. Leftwich and others for about $5,000,000.

Purchase negotiations were handled by San Juan Exploration Co. under an agreement placed in effect early this

year when Producing Properties was formed to acquire oil and gas properties. Engineers for San Juan Exploration estimate reserves of the Reinecke properties involved in the sale at more than 5,000,000 bbl.

The Reinecke pool is noted as one of the most prolific Canyon reef fields in West Texas. It had produced 12,131,000 bbl. of oil to April 1 and currently is producing 8,060 bbl. daily from 70 wells. Plans are being formulated to unitize the field.

Water-Flood Permit Asked

AUSTIN. — Tennessee Gas Transmission Co. sought a permit here last week to water flood the Grayburg pay horizon in World field of Crockett County, West Texas.

The company based its application to the Texas Railroad Commission on the successful outcome of a pilot flood in the field. The company said gravity injection of about 1,000 bbl. of water daily through its No. 10 well for the past 6 months has hiked oil production in offsetting producers about 30 bbl. each. The pilot test was launched last November 15.

World field takes in about 5,000 acres. The Grayburg pay has produced 108,000 bbl. per well and 4,170 bbl. per acre. Cumulative production is more than 20,850,000 bbl.

Robert Siberson, Tennessee engineer, said field production began to decline in 1953 and dropped 16 per cent in 1954. Present per-well average is 17 bbl., and Siberson said he thought this would drop to 3 bbl. per well in 10 years if repressuring were not started.

University Lease Sale Set

AUSTIN.—A public auction of oil and gas leases on approximately 56,000 acres of University of Texas lands will be held Tuesday, June 28, in the Commodore Perry Hotel here.

Leases will be offered on 149 tracts, mostly in West Texas. The tracts are in Andrews, Martin, Ector, Crane, Upton, Reagan, Crockett, Irion, Pecos, Winkler, Ward, Loving, and Cooke counties.

The June 28 sale will be the thirty-fifth in a series of public auctions conducted by the Board for Lease of the University of Texas Lands. Berte R. Haigh, geologist in charge, noted that two variations are being made from the usual lease schedule. The date has been changed from Friday to Tuesday, and the site has been changed from the Stephen F. Austin Hotel to the Commodore Perry.

The auction will start at 10 a.m. The board reserves the right to reject any or all bids.

ROCKY MOUNTAIN

Utah Test Hits

Well near Pacific Northwest tests gas from three zones

SALT LAKE CITY.—Another eastern Utah gas discovery has been added along the Pacific Northwest pipeline route.

Kanab Uranium Co. tested gas in the Dakota and Morrison zones at its 1 Government in Grand County's West Salt Valley area. A test of the Dakota zone at 3,161-3,203 ft. flowed up to 1,000 M.c.f. of gas per day. The Morrison test fared better, with an estimated flow of 6,000 M.c.f. of gas per day from 3,258-87 ft. Some light-green oil accompanied the gas flow. Another sand about 200 ft. lower flowed 1,000 M.c.f. per day. Kanab is drilling ahead to test the Entrada.

This indicated gas discovery is about 60 miles southwest of Bar-X field, where Morrison and Entrada gas production is found.

Gasoline Plant Output Sold

KIMBALL, Neb.—Kansas-Nebraska Gas Co. has agreed to buy the entire output of a new high-pressure, absorption-type gasoline plant being constructed in the Long field in southern Kimball County, Nebraska, by Kimball Gas Products Co., Odessa, Tex.

The processed gas will be transported east from the field through a 26-mile, 6-in. pipeline. The line is under construction and is expected to be completed by August 1.

Kansas-Nebraska now has under contract the entire output of three of the four major gas areas in Nebraska. They are the Kimball County area, the West Sidney gas pool, and the Big Springs area in Deuel County.

The gasoline plant, also scheduled to be completed by August, will have an initial capacity of 7,500,000 cu. ft. of wet gas daily from Long, Enders, and Dietz fields. This can be increased to 10,000,000 to 12,000,000 cu. ft. daily as the supply of gas becomes available.

Daily liquid production will be 10,000 gal. of gasoline, 12,000 of butane, and 15,000 of propane.

Flood Approved

Texaco to test secondary recovery in Montana field

HELENA, Mont.—The Texas Co. has received permission from the Montana Oil and Gas Conservation Commission to conduct a pilot water flood in Kevin-Sunburst field.

The test project will be started within a month and completed by October 1. It will be conducted in a 10-acre tract.

Water will be injected at the rate of 450 bbl. daily into the Madison formation. The water will be piped from other Texas Co. wells about 3 miles away.

Texaco controls 217 of the approximately 1,400 producing wells in the field. Moore said average production has declined to where many wells must be abandoned unless recovery can be increased.

Colorado Gets Big Bonus

DENVER.—One of the highest bonuses ever paid for a Colorado oil and gas lease was received last week by the Colorado Land Board.

Joseph W. Burke, Jr., Denver, paid $26.75 an acre for 635 acres in Baca County, in extreme southeast Colorado near the Oklahoma line. The area is a considerable distance from Colorado's established oil and natural-gas fields. In addition to the bonus of $16,986, Burke paid the regular 50-cent an acre per year leasing fee and 10-cent per acre filing fee.

Conservation Bill Signed

DENVER.—Colorado now has an oil and gas proration system.

Gov. Ed C. Johnson last week signed a bill recently passed by the state legislature that calls for the appointment of a new oil and gas conservation commission to regulate state's oil and gas industry. The new commission will have one member from each of Colorado's four congressional districts and one at large. The commission will have the power to prorate production and take other steps needed to prevent waste.

Bolivian Industry Grows

Tractors working on world's highest pipeline will have aircraft superchargers; "petroelectric" plant proposed

CONSTRUCTION of the world's highest pipeline, at elevations requiring tractors to be equipped with aircraft-type superchargers, soon will start in Bolivia.

The South American republic's ambitious plans for expansion of its oil industry also call for other pipeline novelties—batching of crude oil through a products line, and construction of the world's first "petroelectric" plant.

The lofty pipeline will be a 6-in. products system at elevations up to 14,834 ft. It will extend from Cochabamba, site of a 6,500-bbl. refinery, to Oruro and La Paz, the capital.

Contract for this line has been let to Williams Brothers, Tulsa pipeline contractors. The 220-mile system will be built in two stages. The first phase of the project will extend from Cochabamba to Oruro, a distance of about 93 miles. From there, the line will extend 127 miles to the northwest to serve the capital city.

Another projected products line would provide a new outlet for Bolivia's other refinery, a 4,800-bbl. plant at Sucre. This would be a 6-in. line linking Sucre with Oruro.

The country's two major refineries are served by crude lines from the rapidly expanding Camiri field, Bolivia's biggest producer. Camiri crude also has an outlet into Argentina. A recently completed 156-mile, 6-in. line moves about 2,700 bbl. of crude daily to Yacuiba, on the Argentine border. Plans call for a 96-mile extension of this line to Bermejo.

Long-range plans . . . With continued growth of Bolivia's oil production, the government hopes to start exporting crude to the world market through a pipeline to the coast of Chile.

Williams Brothers has started preliminary plans for an 8 and 10-in. line from a point near Oruro to Arica, on the Pacific coast. Plans for the project were revealed by Mario A. Montenegro, director general of petroleum for the Ministry of Mines and Petroleum in Bolivia.

At a recent visit in Tulsa, Montenegro predicted that production of crude oil in Bolivia will rise to 15,000 bbl. daily by the end of the year. He estimated present potential output at 12,000 bbl. per day.

The crude line to the coast would tap the Camiri-Oruro system at Sicasica, a point near Oruro. It would be more than 215 miles in length and would drop from an elevation of nearly 15,000 ft. to sea level within 48 miles.

When production increases enough to warrant the new outlet, crude would be batched through the products system to Sicasica.

Power plant . . . Because of the fast drop to the coast, plans are being made to use the crude-oil pressure to drive a turbine. This would generate enough electricity to supply Arica, a city of about 30,000 people. Preliminary engineering for the petroelectric system is being done by Williams Brothers. Construction on the line is expected to be started in about a year.

To reduce pressure in the line dropping from the Andes, stop stations would be built along the last 48-mile link.

Officials figure the proposed petroelectric plant would not be feasible when the line is first put in service. At the present rate of production, only about 7,000 bbl. of crude per day could be exported through the line. Bolivia consumes about 5,000 bbl. daily, and about 3,000 bbl. more is exported to Argentina.

Estimates show that with production of 25,000 bbl. per day, pressure in the line might be sufficient to generate power for the coastal city. The power plant would be the first of its kind.

While continuing plans for future pipelines, Williams Brothers is now faced with the problem of finding a means to lay the products line across the Altiplano Plateau. Because of scarcity of oxygen at such levels, the company is trying to get superchargers for its tractors from the aircraft industry. Use of such equipment on tractors laying a pipeline is unprecedented.

Economic importance . . . The elaborate plans for expansion of the Bolivian oil industry are being directed by Yacimientos Petroliferos Fiscales Bolivianos, the government oil agency. Montenegro is the government's representative on the Y.P.F.B. board. The agency is an autonomous organization. It is responsible to the Ministry of Mines and Petroleum but is not run by it.

Much of the growth of Bolivia's oil industry is due to last year's discovery of a deeper productive zone in Camiri field. With three new rigs working in the field, Y.P.F.B. hopes production will continue to mount rapidly.

Already the expanding industry has had a dramatic effect on Bolivia's economy. Until 1952 the country was importing about $9,000,000 worth of crude and products each year. Now the country is a net exporter of oil.

Libya Passes Law

Bill allowing exploration by foreigners goes to king

LIBYA'S new oil legislation has received the approval of the Libyan House of Deputies and the Senate. It now needs only the approval of King Idris to become law.

The bill would permit foreign companies to carry out full-fledged exploration in Libya. British, French, and American firms have shown an interest in the former Italian colony. Negotiations to open the country to foreign operators were begun after Libya was granted independence and self-government by United Nations fiat January 1, 1952.

American companies which have indicated interest in Libya's prospects include Standard Oil Co. (N. J.); Socony Mobil Oil Co., Inc. (formerly Socony-Vacuum); American Overseas Petroleum, Ltd. (Caltex); Conorada Petroleum Corp.; and Hunt Oil Co., of Dallas.

In addition to the five American operators, four European companies have carried out geological work and probably will apply for concession acreage. They are British Petroleum Co., Ltd., Royal Dutch-Shell, Omnium Francaise de Petrole, and Cie. Francaise des Petroles. Omnium Francaise's interest has been principally in the Fezzan. Most of

the other companies are interested mainly in the two other provinces, Tripolitana and Cyrenaica.

The law goes into effect 30 days after its publication. There is then a 1-week filing period. All applications received during this period are treated equally whether filed on the first or last day. Applications for the same leases must be settled by the companies involved. The law is expected to be published May 20, and the initial filing period probably will be the last week in June.

Libya has an area of about 1,100,000 sq. miles, of which 3 per cent is arable land. Most of the area is covered by sedimentary basins which are comparatively unknown geologically. The present premier is Mustafa ben Halim, a 34-year-old engineer educated abroad.

The proposed law is expected to be generally acceptable for private foreign investment. Royalty to the government is fixed at 12½ per cent, and a 50-50 profit split is provided for after export production reaches 15,000 bbl. daily.

The law would divide Libya into four zones, Tripolitania, Cyrenaica north of the 28th parallel, Cyrenaica south of this line, and Fezzan. Operators would be limited to 11,600 sq. miles in zones 1 and 2, and 31,000 sq. miles in zones 3 and 4 *(The Oil and Gas Journal, December 20, 1954, page 74)*.

Austrian Oil at Stake

Preliminary agreement calls for Russia to forfeit fields and refineries in return for 10 annual crude payments

Dahl M. Duff

THE future of Austria's petroleum industry was being shaped last week in four-power negotiations in Vienna on terms of an Austrian treaty.

Representatives of United States, Britain, and France were pressing for restoration of rights over concession areas held before Nazi Germany's annexation of Austria in 1938. It is in these areas that the Germans during the war and the Russians since have made several important field discoveries.

For a time the oil problem loomed as a major stumbling block in the treaty discussions. However, the foreign ministers were represented as feeling that an Austrian settlement must not fail because of the oil issue.

The occupation of Austria has continued since the end of the war because Russia has consistently blocked efforts of the Western powers to reach acceptable treaty terms. A draft was drawn up in 1949 after prolonged negotiations, but was never ratified. Then, in mid-April, the Austrian chancellor, Julius Raab, went to Moscow at Russia's invitation and quickly worked out an agreement on the main treaty points. This settlement forms the basis for the current ambassador-level meetings in Vienna.

Terms of agreement . . . The agreement Raab brought home from Moscow called for Russian surrender of the Vienna basin fields. These areas account for all of Austria's estimated 57,500 bbl. daily crude output. They lie in the Soviet occupation zone and were taken over by the Russians at the end of the war on grounds they constituted German assets to which Russia was entitled under the Potsdam accord.

In return for restoration of the producing areas as well as several small refineries, Austria agreed to deliver 1,000,000 tons of Austrian crude annually for 10 years. This amounts to about 20,000 bbl. daily, or approximately a third of the country's total. In addition, Russia demands another 300,000 tons a year—about 6,000 bbl. daily. These shipments would be included as a part of the $150,000,000 worth of commodities Austria would export to Russia in payment for former German enterprises confiscated by Russia.

Obstacles . . . What the Western representatives apparently refused to give in to was another Russian demand for an Austrian guarantee that the restored oil properties be kept out of foreign hands. The trouble here is that much of the current production comes from fields developed in areas where Western companies held long-term concessions prior to 1938. An Austrian source said the Western operators would receive 40 per cent of the country's total production if the concessions were returned to their pre-1938 owners.

Another complicating factor is that the Austrian Parliament passed an act nationalizing the oil industry in July 1946. Since all the properties were under Russian control, the measure had little practical significance and was held in abeyance. However, Socialists are now pressing for a state monopoly in future oil operations.

Since the Western powers are anxious to reach an agreement on a treaty which will get Soviet troops out of Austria, there was talk early last week of a compromise on the oil question. Austrian sources said this plan would return the pre-1938 properties to the Western companies but would grant to Russia 15 to 20 per cent of the production from fields developed postwar by the Russians. In addition, the Western companies would be required to provide half the 1,000,000 tons a year to be delivered by Austria in the next 10 years.

Scope of treaty . . . These questions affect the approximately 90 per cent of Austria's production which is under direct control and operation of the Russians. The other 10 per cent, also in the Russian zone, is produced by the Western companies which are required to sell their output at a fixed price to the Soviet Mineral Oil Administration.

The two companies—Rohoelgewinnungs, A.G. (R.A.G.), jointly owned by Royal Dutch-Shell and Socony Mobil Oil Co., Inc., and the Canadian operator, Col. R. K. Van Sickle—presumably will continue in control of these small and largely depleted fields after a state treaty ends the occupation.

History of industry . . . Austria's oil industry has been a continual prize of war and occupation and has suffered accordingly from rapid production and uneconomic field practices. First exploration was undertaken in the Vienna basin in the 1920's, and commercial production began in 1938 in the Zisterdorf region about 30 miles northeast of Vienna.

A group of German companies took over after the annexation in 1938 and production was pushed to a wartime high of about 24,000 bbl. daily in 1944. When the Russians moved in in 1945, the properties were seized, although R.A.G. and Van Sickle were allowed to return and operate their older fields.

The Soviet Mineral Oil Administration began intensive exploratory work and made a series of discoveries, some on structures mapped prewar by the Western companies. These were Matzen in 1949, Aderklaa in 1950, and Blockfliess in 1951. These new fields now account for most of the country's output.

The Austrian refining industry consists of several small plants with an aggregate of about 30,000 bbl. daily capacity. All are in the Russian zone and operated by the Russians except for the Socony Mobil plant at Kagran and the Shell plant at Floridsdorf.

Russians closely supervise operations, requiring the companies to sell their products back to the Soviet Mineral Oil Administration at a fixed price.

Peron Backs Oil Deal

Argentine president quiets opposition, asks congress to approve California Standard concession for nation's good

ARGENTINE President Peron last week submitted to congress an exploration contract granting oil concessions to Standard Oil Co. of California. He recommended its approval.

The agreement reached a few weeks ago with the government *(The Oil and Gas Journal, May 2, page 69)* is the first foreign-oil concession granted by the Argentine Government in nearly 20 years.

Although the Standard of California contract is drawing strong opposition from ultra-nationalistic groups, the firm backing of Peron apparently will assure its eventual approval in congress.

The government has been discussing other proposals with Standard Oil Co. (N.J.) and Royal Dutch-Shell, but these negotiations are reported temporarily suspended.

In asking congressional approval of the agreement, Peron sought to quiet opposition. He declared the contract in no way deviated from the government's principle of "self-determination." He said the legislation was an urgent necessity because the government oil agency, Yacimientos Petroliferos Fiscales, had been unable to meet oil requirements resulting from the country's industrialization. He added that 60 per cent of the nation's current-needs are being imported with consequent serious drain on the republic's exchange.

New details . . . Entrance of foreign capital will mean development of the country's resources, Peron told the deputies. Argentina has first call on all crude petroleum produced under terms of the agreement, he pointed out.

More details of the contract were disclosed with its presentation to congress. The earlier outline of the terms disclosed that Standard of California was committed to spend a minimum of $13,500,000, that oil would be sold for domestic refining at a price 5 per cent under the world market, and that there would be the usual 50-50 split of profits.

The 75-page document submitted to congress contained provisions giving the company right to construct a refinery and organize a subsidiary to market its products within the country. At present, the only foreign-owned refineries in Argentina are plants of Jersey Standard and Royal Dutch-Shell.

Several years ago a joint Socony Mobil and Texaco subsidiary was forced to sell its Argentine refinery to the government because of difficulties in importing crude and other problems.

The company's concession covers an area of 49,800 square km. (about 11,800 sq. miles) located in the western part of the territory of Santa Cruz near the Chilean border. The contract carries a 40-year term, renewable for another 5 years. Minimum expenditure must be made during the first 4 years, and operations must begin within 6 months after the agreement becomes effective.

No limit on profits . . . Imports of equipment and other materials necessary for the operations can be made free of duty and taxes and without authorization of the Central Bank. The company has the right to construct pipelines, shipping facilities, airports, and communications systems required for its own use. It is allowed to purchase foreign exchange at the most favorable legal rate. There are no limitations on the profits which are freely remittable. Profits from refining are to be treated the same as those of other refining operations. National needs must be met before any export of crude oil.

The government can cancel the agreement in the event the company fails to meet the specified obligations. Special provisions call for arbitration of contract disputes.

Standard of California will operate in Argentina through a new Delaware subsidiary, Cia. California Argentina de Petroleo. The agreement was signed on behalf of Standard of California by Owen James Haynes, vice president of the new Argentine subsidiary.

Standard of California first made its proposal to the government last September. This action, along with the other exploration and development offers of Jersey Standard and Royal Dutch-Shell, followed an earlier reversal of previous government policy under which foreign oil companies were virtually barred from concessions in the country.

Jersey Standard and Royal Dutch-Shell's present Argentine production comes from concessions granted prior to the 1935 oil law which limited oil rights to joint operations with the government.

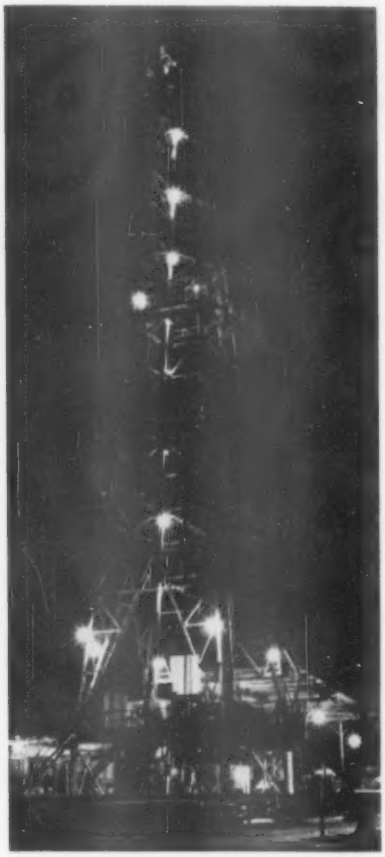
Trinidad Finds Oil in Gulf

Trinidad's first offshore well from a platform has made a discovery in the Gulf of Paria. No details on test results, formations, or quality of the oil were available. The well was reported to have made a strike at around 7,500 ft.

The operation is being carried out by Trinidad Northern Areas, Ltd. This company is owned equally by British Petroleum Co., Ltd., United British Oilfields of Trinidad, Ltd. (Royal Dutch-Shell), and Trinidad Leaseholds, Ltd.

Lake Maracaibo Line Inspected

The final work joining ends of a new pipeline from Lake Maracaibo to Palmarejo is inspected by officials of Cia. Shell de Venezuela. Visitors on the barge are J. H. Loudon, a company director; I. D. Davidson, general manager; and W.F.G.L. Starrenburg, western division manager. The 45-mile line connecting Shell's Lake production to Palmarejo was built in 3 months at a cost of $9,700,000 (The Oil and Gas Journal, May 2, page 69).



Nigerian Test Deep

Drilling continues below 12,000 ft. at remote well

THE No. 1 Nzam wildcat of Shell-D'Arcy Petroleum Development Co., of Nigeria, Ltd., has passed the 12,000-ft. mark. It is the deepest test ever drilled in Nigeria, a British protectorate. So far, no oil in commercial quantities has been found.

The well was spudded April 22, 1954, in remote bush country. Drilling has been continuous except for a 1-week period last fall when the Niger River overflowed and flooded the rig site and camp area.

No. 1 Nzam is one of several wildcats being drilled by Shell-D'Arcy. Showings of gas and oil were found in two wells at Akata and Ituk Mbang in Calabar Province.

Shell-D'Arcy began exploration work in 1937, but it was suspended in 1940 because of the war. Operations were resumed in 1946 and geological, seismic, gravimetric, and core-drilling work has been carried out over a 58,000-sq.-mile concession area.

Seepages of bitumen have been known for many years in West African country. Between 1907 and 1913 two British companies drilled about 15 wells ranging from about 350 ft. to 3,100 ft. in depth. Oil and gas were reported at several of the wells, but no commercial production resulted.

Shell-D'Arcy is a subsidiary of Royal Dutch-Shell and British Petroleum Co.

Kuwait Test Hits

Wildcat goes deeper after testing oil in Burgan sand

KUWAIT OIL CO., LTD., has found oil in its 1 Raudhatain wildcat about 27 miles south of the Iraq border in northern Kuwait. The test was started late last summer after a heavy rig was moved intact 99 miles from Ahmadi, the company's headquarters.

A Gulf Oil Corp. spokesman in New York described the well as a "tight hole" and said that drilling was continuing. Industry sources said the well had tested a thick section of Burgan sand and was being deepened with the hope of finding lighter crude in the Zubair formations, which are productive across the border in Iraq.

In the Burgan, the well was said to be a very good producer, even by Middle East standards.

Burgan field in southern Kuwait produces crude of 31°-32° gravity. Together with the associated Magwa and Ahmadi producing areas, it has reserves unofficially estimated at 30 billion barrels. Output during the first quarter of this year was well above 1 million barrels daily.

Labor Session Ends in Row

The fifth convention of the International Labor Organization's petroleum committee has ended abruptly in Caracas after running afoul of the Venezuelan Government.

The committee's directive council called off the meeting after failing to reconcile the government and a Dutch labor leader, Adrian Vermuelen, who had been expelled from the country for statements which Venezuelan authorities called "interference" in the country's internal matters.

A protest against suspension of the meeting was lodged by the Venezuelan Government, and a midnight communique announced Venezuela's withdrawal from the I.L.O., a specialized agency of the United Nations. The government charged the I.L.O. was "an instrument of political and sectarian maneuvers which converts it into a demagogical rostrum."

Purpose of the conference was to carry out a "study of human relations in the oil industry," and to review latest events and progress.

International Briefs

The first furfural plant outside the United States has gone into operation at La Romana, Dominican Republic. Although the plant potentially could help supply the oil industry, two-thirds of its 30,000,000 lb. maximum annual output is contracted for by E. I. du Pont de Nemours & Co., Inc., for use in nylon manufacture. The $6,000,000 unit will process shredded cane stalks after sugar is extracted. Central Romana Byproducts Co., a subsidiary of South Puerto Rico Sugar Co., will operate the plant.

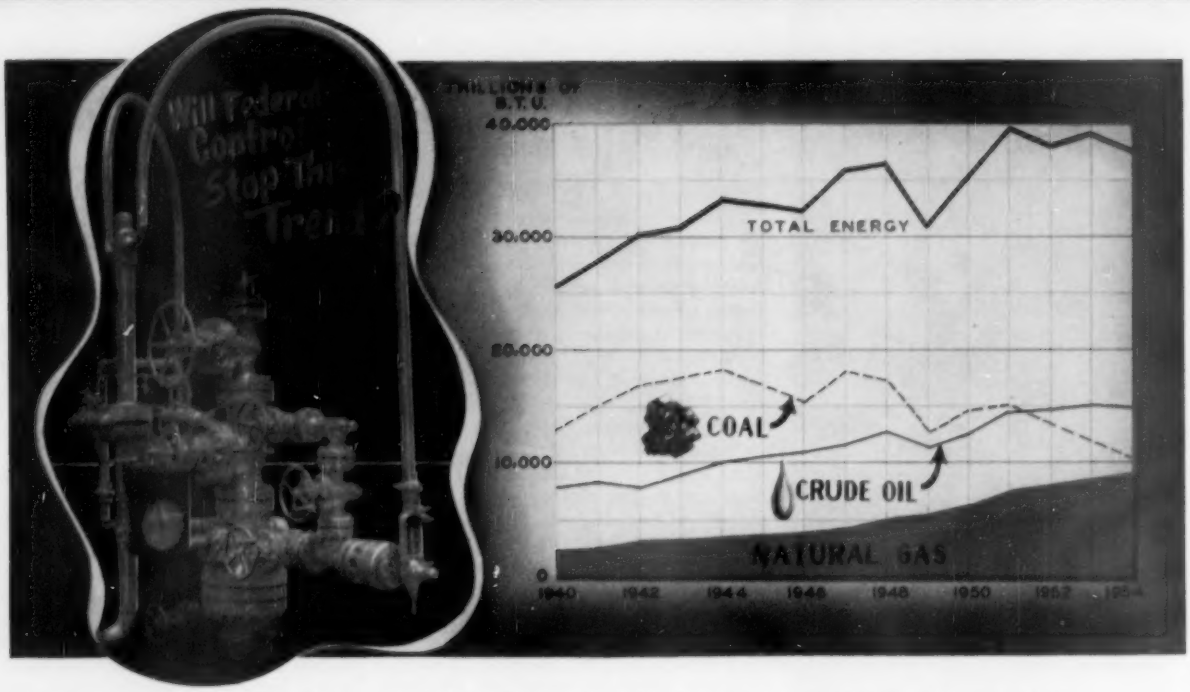
Oil reportedly has been found by a remote wildcat in the Jura Mountains of eastern France. Details were not available. Oil exploration in this area has been conducted by a subsidiary of French coal interests.

Two French oil companies in the Pechelbronn group will merge. Antar S.A. d'Exploitations Petrolieres, a marketing firm, will combine with a refining company in which it has interests, Raffineries Francaises de Petrole de l'Atlantique. Antar's import permit for 204,700 tons (about 1,740,000 bbl.) of gasoline a year, and 40,000 tons (about 28,000 bbl.) of lubricating oil a year will be transferred to the new firm, Soc. Antar-Petroles de l'Atlantique.

A Houdriforming unit including a Houdry guard case pretreating section will be installed by Gewerkschaft Erdoel-Raffinerie Emsland at its refinery in Lingen, West Germany. The unit will be built by Lummus Co., Ltd., London, and based on process designs by Houdry Process Corp. It will have a capacity of 3,500 bbl. daily. Capacity of the refinery is 11,000 bbl. per day.

A large vinyl-acetate plant is under construction at Salt End, Hull, as another addition to Britain's expanding petrochemical industry. A new company, Hedon Chemicals, owned by Distillers Co. and Shawinigan Chemicals, of Canada, is building the plant. The product, a raw material for plastics, will be marketed by Shawinigan, Ltd., of London, and British Industrial Solvents, a division of Distillers.

Synthetic rubber will be produced by a new French company, Ste. du Caoutchouc Butyle. Ten oil-refining, rubber-manufacturing, and chemical companies set up the company with a capitalization of about $30,000,000. The parent companies include Esso Standard S.A. Francaise and Raffineries Francaise des Petroles.



Here's picture of how the nation has been supplied its energy from mineral fuels as . . .

Gas Girds to Fend Off Federal Control

Phillips decision unites industry in a drive for corrective legislation. Battle lines are being drawn but gas is ready

by Dahl M. Duff

THE natural-gas-utility industry made further sharp gains last year, but its long-term future is clouded by federal regulation of the producing side of the business.

Few other industries in the country have shown the phenomenal rate of growth that has become commonplace with natural gas since the end of World War II. With the construction of a web of long-distance transmission lines extending out of the Southwest into virtually every major consuming area of the country, natural gas during the last decade has risen to the position of a major contributor to the fuel requirements of the country.

One distributing utility after another has abandoned manufactured gas to tie into this source of supply. The extent to which natural gas now dominates the entire gas-utility industry is reflected in the fact natural gas sales make up 94 per cent of the industry total. The pipeline system has become so extensive that the housewife in California uses gas which a few years ago was flared in West Texas, or a New Jersey ceramics plant burns fuel coming from wells in the Lower Rio Grande Valley.

The great growth of natural-gas use has been promoted by the basic economic factors of supply, demand, and price. Gas was long regarded as a pure byproduct to oil operations, and when the postwar wave of pipeline construction began, large undedicated reserves were easy to find. Utilization was accelerated by steps against gas flaring by state regulatory agencies, particularly the Texas Railroad Commission.

Why it's popular . . . On the consuming end, natural gas was, and still is, in heavy demand because of its cleanliness, convenience, and low regulated price. Technological developments made it possible to transport gas halfway across the country, and state regulation in most cases kept the ultimate

price well below that for coal and oil.

The result of these favorable conditions has been an outlay of around $7,850,000,000 on natural-gas utility and pipeline construction work in the period 1946-54. During this 8-year period, customers receiving natural gas from the distributing utilities rose from 9,366,000 to 22,026,800 last year, a gain of 136 per cent. At the same time natural-gas-utility sales skyrocketed 152 per cent to last year's 57,617 million therms. Using the rough conversion of 1 therm equaling 100 cu. ft., this means that nearly 16 billion cubic feet of natural gas was moved daily to utility customers last year.

Up until June of last year, the possibility of federal regulation of gas production was only a somewhat vague background threat amid all this pipeline building and expansion. Some of the larger oil companies, however, saw trouble on the legal horizon and held their gas reserves off the interstate market on the chance that the federal Natural Gas Act of 1938 might be extended to include production with consequent difficulties for their oil operations.

The nightmare of federal regulation burst on the gas-producing industry June 7, 1954, when the U. S. Supreme Court held that Phillips Petroleum Co.'s sales to Michigan-Wisconsin Pipe Line Co. made it a "natural-gas company" under the 1938 law. The effect of the decision and subsequent implementing orders of the Federal Power Commission was to bring thousands of gas producers in a utility status, making their rates and contracts subject to FPC jurisdiction and approval.

Industry united . . . The Phillips decision has united the whole oil and gas-producing industry in a determined drive for corrective legislation in Congress. Few other issues have drawn the industry together in such unanimity as this one. Many producers believe that it is only a step from federal regulation of gas production to federal regulation of oil production. Besides, in the opinion of the producers, there is no more basis for regulating producers of gas than there is, say, for regulating production of coal as the principal raw material of electric utilities.

The industry's support has been rallied behind the Harris bill (H.R.4560) which was the subject of hearings before the House interstate and foreign commerce committee in April. The Harris bill would amend the Natural Gas Act to exempt gas producers and gatherers. The industry's position is that such a change simply carries out the original intent of Congress. Section 1 (b) of the act as passed in 1938 declares its provisions "shall not apply to any other transportation or sale of natural gas or to the local distribution of natural gas . . . or to the production or gathering of natural gas."

More ammunition was given the legislative effort when President Eisenhower's Advisory Committee on Energy Supplies and Resources Policy declared itself against federal regulation. When this group brought in its recommendations a few months ago, it said, with regard to natural gas:

"In the interests of defense and consumer interests by assuring such a continued exploration for and development of adequate reserves as to provide an adequate supply of natural gas, we believe the federal Government should not control the production, gathering, processing, or sale of natural gas prior to its entry into an interstate transmission line."

Chief opposition . . . The main opposition to amending the act has come from some of the state regulatory agencies, officials of gas-consuming states, and distributing gas utilities. What has been particularly under attack are the various clauses in gas-sales contracts

Gas Price for Home Heating Has Changed But Little

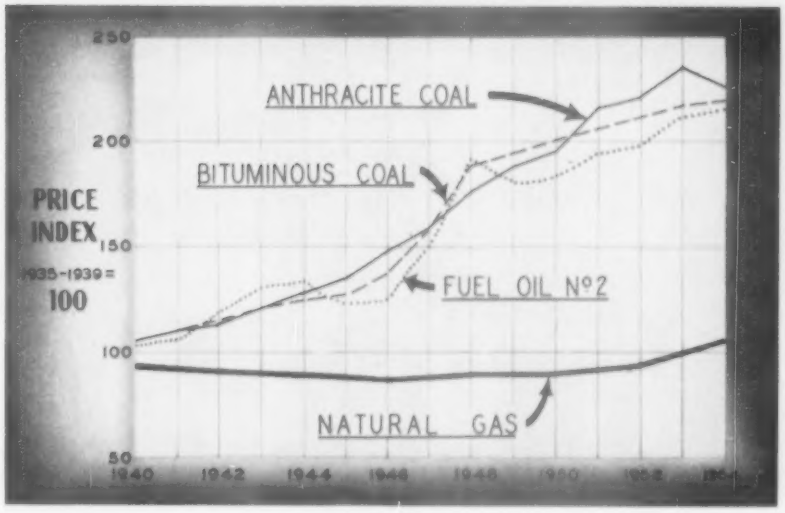


Fig. 1.

Field Price Is Only a Small Part of Home Consumer Price

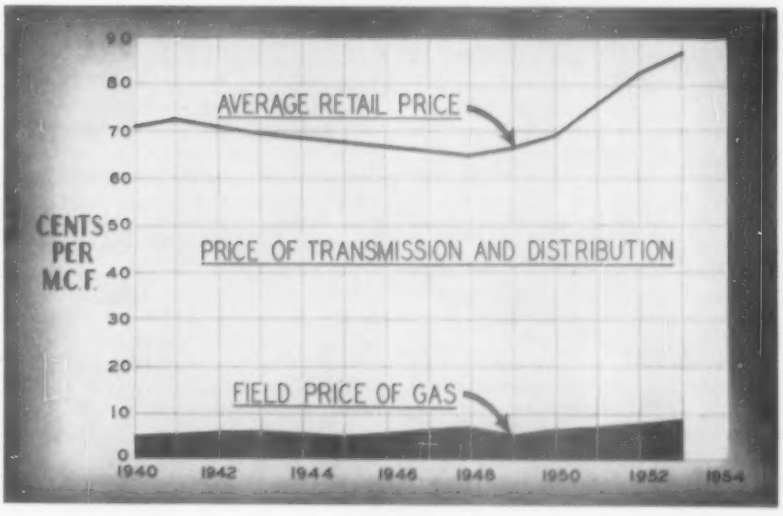


Fig. 2.

New Supply Compared With Net Production and Field Price

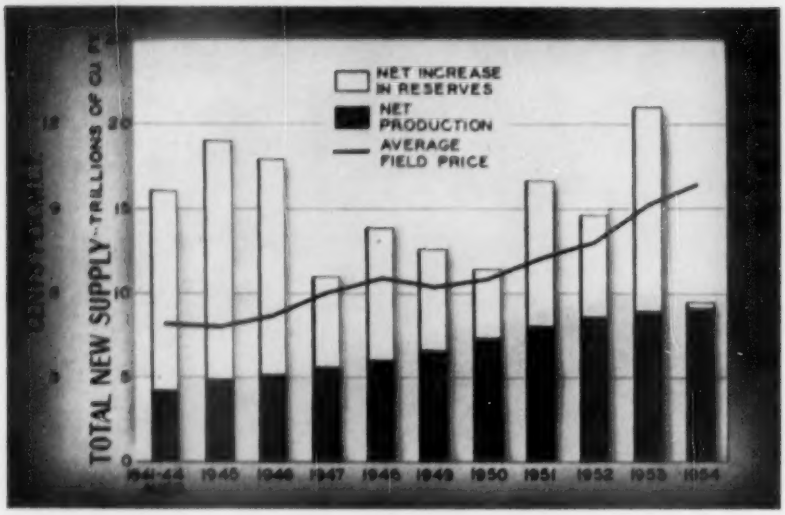


Fig. 3.

Natural Gas . . . Natural-Gas Pipelines

by which producers have sought to protect themselves during recent years as gas prices have increased.

These clauses came into use after 1945 and take a variety of forms. They have been condemned by gas-distributing companies on grounds that their practical operation results in continuously spiraling effect on prices at the "city gate"—the point where gas is received by the distributing company from the interstate transmission line. In the interests of clarity, here is a short glossary of the clauses which show up in connection with sales contracts between gas producers and transmission company:

1. Escalation clause, three general forms.

(a) Simple, fixed, and automatic, all mean the same. They provide for price increases at stated time intervals, for example, a quarter cent a year. Such clauses are in common use.

(b) Spiral escalation. These provide that the producer will get a predetermined percentage of any increase received by the pipeline.

(c) Price index. These call for price adjustment according to the movement of some agreed-upon price index. Such clauses are only rarely used.

2. "Favored-nation" clauses are of two general forms. The name comes from the same term used in international agreements.

(a) First-party, also called two-party. This is the most common type. It provides that the producer's price goes up to the level of the whatever higher prices are negotiated later in the same field and in comparable volumes by the pipeline with which he has a contract.

(b) Third party. This is less common. It allows the producer an increase to the highest price paid by any buyer for gas in the same field in comparable volumes. In this case, the purchaser is bound to pay the best price paid by other buyers in the producing area.

3. Renegotiation or price-redetermination clauses. These provide a review of the gas price at stated intervals and frequently a formula for determining the new price. Arbitration often is called for in the event the producer and pipeline cannot reach agreement.

Escape clause . . . In addition to these clauses dealing with future price increases for the producer, many gas contracts contain a so-called escape clause included at the insistence of the producer. This provides for automatic cancellation of the contract in case federal regulation is imposed on the producer.

In testimony before the House committee, one important distribution-company witness, Randall J. Leboeuf, Jr., appearing for Consolidated Edison Co., New York, and 13 other Northeast utilities, endorsed the Harris bill in general but asked for changes to outlaw the "more injurious" escalation clauses. Leboeuf clients favored prohibiting virtually all escalation except the simple, fixed, or automatic type.

The industry's defense of these escalation clauses is based on the contention that they are necessary to protect a gas producer who must sign a contract for a long period of time—20 years or more. A Texas congressman at the hearings told Leboeuf he apparently wanted to eliminate all clauses unfavorable to his interests and keep whatever benefited them.

Leboeuf voiced a complaint also heard from several other witnesses representing gas-distribution and consuming interests. This is that the "disorderly and unpredictable" rate increases due to escalation clauses are threatening to price natural gas out of certain markets at the end of the pipelines where there is strong competition with coal and oil.

"So what," was the comment of one oil man to this line of testimony. "Who guaranteed the gas companies a market in the first place?" he asked. "It's a competitive economy, and if the gas companies can't compete, then the market should go to other fuels."

At the hearings, another Texas congressman told Leboeuf that he "couldn't work up much sympathy for the crocodile tears you have been shedding for the consumer when you haven't reduced gas rates to consumers in your area since you began buying gas back in 1951."

In all this discussion over natural-gas prices, several facts are apparent. One is that the low price of the fuel has been a prime factor in stimulating the great expansion in use. Another is that the wellhead price of natural gas is a relatively small component of the final price. Still a third is that the upward trend of field prices in the last 9 years is the simple result of supply and demand as large blocks of pipeline gas became increasingly harder to find for long-term contracts.

Price disparity . . . The 1952 report of the President's Materials Policy Commission, headed by William S. Paley, spoke of the "tremendous bargains" represented by the field price of natural gas. It pointed out that a barrel of petroleum was selling at that time for $2.65, while its thermal equivalent in natural gas was priced on the average at about 30 cents in the same producing regions. This report described how higher gas prices would stimulate exploration both for gas and oil and make it profitable to curtail field loss and waste. In view of the usual ratio of gas-oil discoveries, a 5-cent increase in the gas price is equivalent to a 30-cent increase in the price of a barrel of crude oil.

Lyon Terry, the Chase Manhattan National Bank's authority on the natural-gas industry, has this to say on the subject: "The fact of the matter is that natural gas has been underpriced with respect to oil, which, together with the improvement in transportation technique, has brought about the rapid growth of the gas business in comparison with that of domestic crude con-

sumption. . . . In terms of B.t.u. content, the known reserves of natural gas are 20 per cent larger than those of crude oil, while the production of gas is only 64 per cent of that of crude oil. This production ratio has been increasing . . . and will no doubt continue to increase as a relative price of natural gas increases, until the proportion of the production of the two fuels approaches more nearly the proportion of their respective reserves."

The accompanying chart, Fig. 1, is taken from the testimony given by John W. Boatwright, Standard Oil Co. (Ind.) economist, at the hearings on the Harris bill. It emphasizes how gas prices have risen relatively little in the face of sharp increases in the price of competitive fuels. Much of this stable trend of gas prices is due to the fact that interstate transmission and local distribution are regulated public utilities.

Boatwright's testimony dealt more directly with the fact that field prices make up only a small part of the final gas price. He considered the final price to be the price paid by the residential consumer. From this standpoint the field price represents around 10 per cent of the total. Distribution-company representatives, in blaming rising field prices for their troubles, made their comparisons with the average price for all their sales—residential, commercial, and industrial—a much lower figure. Industrial gas is often sold at little more than the transmission pipeline's price to the distributor. This is the interruptible gas load which the utility has the privilege of cutting off during the winter period of heavy demand from its other preferred customers, customers who incidentally pay much higher rates.

Price trend . . . In 1938, the average price per thousand cubic feet (M.c.f.)) paid by the residential consumers (see Fig. 2) was 74.2 cents while the average field price was 4.9 cents. By 1946, the two figures were 67.6 and 5.3; in 1951, 76.0 and 7.3; in 1952, 83.1 and 7.8 cents; and in 1953, 86.5 and 9.2 cents. The downward trend in residential prices from 1938 to 1946 resulted from the introduction of natural gas into many markets bringing an increased load factor and lower unit cost.

The industry's case before the congressional committee in behalf of the Harris bill dwelt heavily on the argument that an adequate field price for natural gas must be allowed if the customers of the utility companies are to have assurances of future supplies. The only satisfactory price is that determined by unhindered working of competitive forces. Because of the high element of risk in oil and gas exploration, the complex character of the industry, and the fact that much gas is produced in association with oil, wellhead prices determined in Washington would strangle the continued development of gas reserves.

Although natural-gas reserves now stand at the huge total of 211 trillion cubic feet (according to the report of the A.G.A.'s reserves committee as of January 1, 1955), total new supply added during the last 10 years has, with the exception of 1953, shown a downward trend. Boatwright made it clear that this is a natural result—firming field prices during a period of tightening of new supplies. (See Fig. 3.)

During the first 5 years following the war, the industry was proving up new supplies at an average rate of almost 3 trillion cubic feet for each trillion produced. During the last 5 years, new supply has amounted to less than 2 trillion for each trillion produced. Most striking was the extremely poor showing last year when the industry added 9.7 trillion cubic feet as against a total production of 9.4 trillion cubic feet.

Uncertain supplies . . . The conclusion from these statistics is that the enlarged supplies necessary to meet future requirements of the gas-utility industry are by no means certain. The existing pipelines are backed up in most cases by dedicated 20-year reserves, and the escape clauses in the producers' contracts may be invalid as an avenue to avoid federal regulation. New supplies of gas, however, will be needed to meet constantly growing demand as existing lines enlarge their throughput and new

"The upward trend of field prices in the last 9 years is the simple result of supply and demand as large blocks of pipeline gas became harder to find for long-term contracts."

Concentration Ratios in Natural-Gas-Production Industry

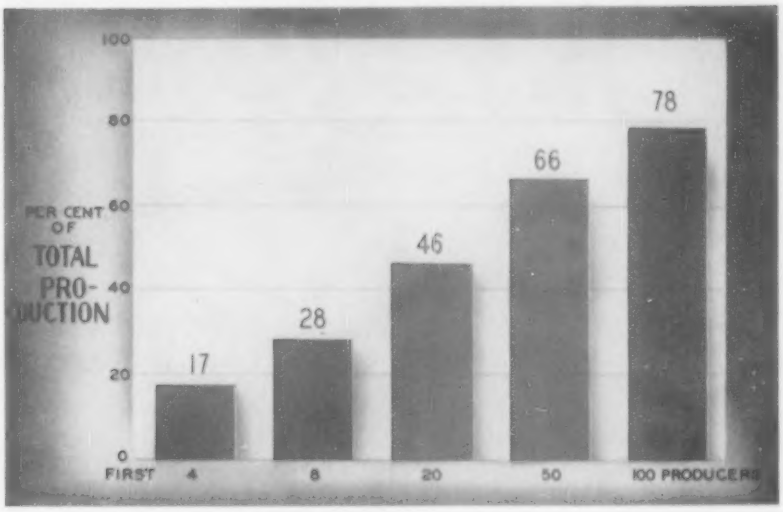


Fig. 4.

TABLE 1—CONCENTRATION OF PIPELINE PURCHASES AMONG VENDORS

	Percentage purchased from—			
	First 4 vendors	First 8 vendors	First 20 vendors	First 50 vendors
United Gas Pipeline Co.	40.61	53.21	71.41	87.85
Northern Natural Gas Co.	67.24	87.83	97.33	100.00
Texas Eastern Transmission Corp.	35.22	55.00	83.63	98.49
Tennessee Gas Transmission Co.	40.42	58.78	81.41	95.60
Cities Service Gas Co.	61.42	80.74	98.25	100.00
Panhandle Eastern Pipeline Co. and Trunk Line Gas Co.	58.69	77.89	90.14	98.86
Colorado Interstate Gas Co.	53.43	79.38	97.45	100.00
Michigan-Wisconsin Pipe Line Co.	100.00			
Texas Illinois Natural Gas Pipeline Co. and Natural Gas Pipeline Co. of America	55.25	84.92	99.26	100.00

Growth of Natural-Gas Pipeline Mileage—All Types

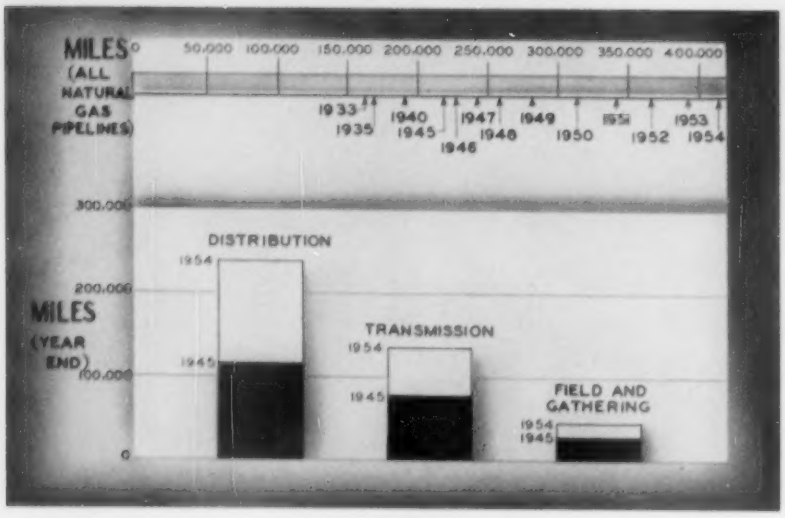


Fig. 5.

ones are undertaken. It is this class of requirements that the producing side of the industry by and large cannot and will not meet if the price is arbitrarily held back by the imposition of public-utility tariffs at the wellhead.

Some of the chaotic effects of utility regulation of gas production have been made plain to producers by past action of the FPC in cases involving the gas-producing companies that are subsidiaries of interstate pipelines. These subsidiaries are regulated by the FPC on grounds that there is no free market or arm's-length bargaining for their gas. To clarify this situation, one section of the Harris bill provides that such pipeline-owned gas reserves shall be sold at the reasonable market price.

Following a Supreme Court's decision in 1945 holding that pipeline-company production could be included in an over-all rate fixing at 6½ per cent return on investment, Colorado Interstate Gas Co. was forced to contribute its own gas to the pipeline at a price of less than 1 cent per M.c.f. The FPC has more recently sought to allow average "fair field price" for pipeline reserves, but there is a legal question as to validity of this action in view of provisions of the Natural Gas Act.

Samuel B. Pettengill, attorney for Pure Oil Co., has cited another case as an example of what the gas-producing industry can expect in the future as a result of the Phillips decision. An interstate gas company subject to FPC's jurisdiction acquired a lease in an unproved area without paying a bonus. Later drilling developed a 68,000-acre field with an estimated trillion cubic feet of reserves. In figuring the price to be charged for the gas, the FPC valued the field in the rate base at zero and allowed a price of a fraction of 1 mill per M.c.f. to cover $1,700 in expenses for the original title papers and title examination. The company was Cities Service Gas Co.

Wide range of sizes . . . There were some 8,100 natural-gas producers in the business at the end of 1954, and this lack of concentration is a powerful deterrent to any monopolistic private control of gas prices, producer representatives have emphasized. The type and size of gas producers run the scale from the smallest operators on up to large integrated oil companies. In addition, there are the royalty interests who control approximately an eighth of the total gas supply. Among the possibilities raised by federal regulation of production is that of the royalty interests electing to take their production in kind and negotiating a separate contract apart from the regulated price received by the producer.

A mass of material was developed by Boatwright to show the multiplicity of individual gas producers. He called attention to the fact that the four largest producers provided only 17 per cent of the total supply and that the first 50 producers controlled only 66 per cent (see Fig. 4). This concentration ratio for natural gas is the lowest of any extractive industry with the single exception of bituminous coal.

The widespread ownership of natural-gas production is further underscored by a study of concentration ratios of smaller areas. The first four companies controlled only 19 per cent of gas supply in seven southwestern states, and only 21 per cent of supply in Texas. The first 50 companies produced 69 per cent of the total in the seven states, and 75 per cent in Texas.

The widespread nature of the interstate transmission lines and their numerous interconnections with each other also argues against a monopoly in the industry. Boatwright pointed out that pipelines extend through many producing areas so that they can obtain supplies from the most advantageous source and that pipelines are constantly reaching out for newly developed production.

Out of nine of the country's largest interstate gas transmission lines, only one shows any dependence on a single supplier for gas (see Table 1). This is Michigan-Wisconsin Pipe Line Co. serving primarily the eastern part of the State of Wisconsin and western Michigan. It draws its gas almost entirely from Phillips Petroleum Co. in the Texas Panhandle.

The FPC recently made a study showing that 90½ trillion cubic feet, or 42.8 per cent of the country's gas reserves, are held by 19 different companies. The FPC study listed the following major owners of gas reserves (figures in trillions of cubic feet):

Humble Oil & Refining Co., 16.0; Phillips Petroleum Co., 13.2; The Texas Co., 10.5; Stanolind Oil & Gas Co., 9.9; Magnolia Petroleum Co., 7.5; Union Producing Co. (United Gas), 4.0; El Paso Natural Gas Co., 3.8; Pure Oil Co., 3.7; Panhandle Eastern Pipe Line Co., 3.5; Skelly Oil Co., 2.3; Atlantic Refining Co., 2.2; Continental Oil Co., 2.2; Ohio Oil Co., 2.1; Sinclair Oil & Gas Co., 1.7; Tide Water Associated Oil Co., 1.7; Shamrock Oil & Gas Co., 1.7; Union Oil Co., 1.6; Sunray Oil Corp., 1.5; and Western Natural Gas Co., 1.4. FPC's staff said there may be others with similar large holdings but that the information was not available.

Natural Gas . . . Natural-Gas Pipelines

". . . an adequate field price for natural gas must be allowed if the customers of the utility companies are to have assurances of future supplies. The only satisfactory price is that determined by unhindered working of competitive forces."

Thus, when the FPC singled out Phillips for determination as a natural-gas company, it struck at the most vulnerable oil company that could have been selected for a test case. Besides being the sole supplier to Michigan-Wisconsin, Phillips is probably the largest producer, gatherer, and processor of natural gas selling to interstate pipelines.

No lack of warning . . . If the Harris bill fails and the gas utilities of the country find themselves with a gradually dwindling supply over the coming years, it will not be from lack of warning from the gas producers. Some observers believe federal regulations will hold increasing quantities of gas off the interstate market. Such a situation could lead to a price differential whereby those producers willing to undergo FPC control would do so only at a higher price than for gas sold purely within the state.

Even with all the tremendous expansion of interstate transmission during the last 9 years, approximately half the gas produced is still disposed of without crossing the state line. Bureau of Mines figures for 1953 (the last year for which such statistics are available) show that the 8.4 trillion cubic feet of production was about equally divided between interstate and intrastate use.

Oil men insist that the likelihood that federal regulation would drive gas production into intrastate markets is more than an idle threat. Although natural gas already has been used as a residential and commercial fuel through the Southwest for many years, and this intrastate market is largely saturated, there is a large potential outlet in new industrial plants and petrochemical facilities.

A straw in the wind was the recently published brochure of the Oklahoma Development Council which said: "A new situation is diverting billions of cubic feet of unsold natural gas from prospective interstate markets and making it available for use only within Oklahoma. . . . Because of the imposition of federal regulation over gas produced for interstate sales, producers are abandoning this market in making new contracts for gas sales. They now plan to hold this gas for use within this state."

Some large industrial plants, especially those using gas for fuel, can gobble up as much natural gas as all the consumers in a fair-sized city. Consumption per customer is usually large, and in 1954, nearly half the total natural-gas production in the United States went to industrial users, much of it in the Southwest. The Bureau of Mines' preliminary report for 1954 shows industrial consumers took 4,048 billion cubic feet out of a total marketed production of 8,667 billion. Other uses were: net stored, 67 billion; residential, 1,937 billion; commercial, 605 billion; field use, 1,578 billion, and carbon black, 247 billion. The remainder of about 185 billion was lost in transmission and unaccounted for.

Natural-Gas Customers, Yearly Averages (A.G.A. Data)

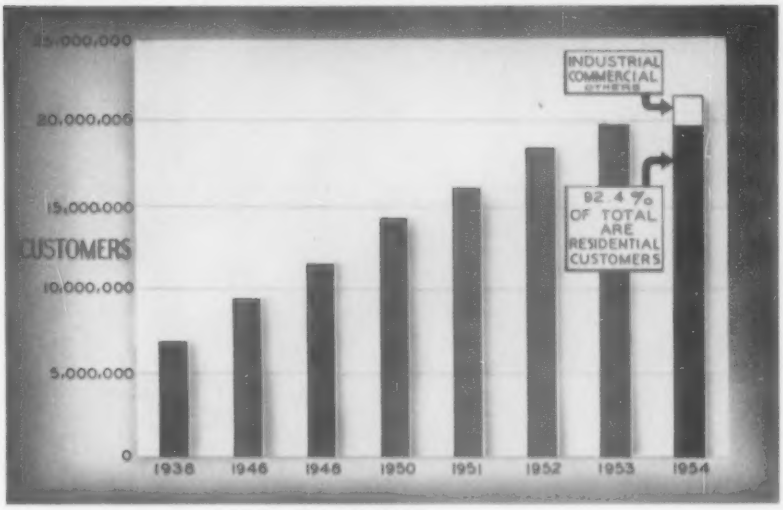


Fig. 6.

No certainty of relief . . . But it is not at all certain that the Harris bill or some other acceptable legislation to remove what gas producers regard as an intolerable situation will be passed by Congress. The industry for several months has had under way a major public-relations program aimed at presenting its side of the issue. On the other hand, the opposition has been working on fears of consumers of wholesale increases in the retail price of gas. President Eisenhower has not yet declared his position, despite the favorable cabinet committee report on fuels policy, but it is believed he would follow Congress in approving exemption legislation. As for some of the substitute bills proposed by gas distributing utilities which provide exemption from regulation but with serious limitations on contracts, one producing official commented this would be "like getting us out of jail and putting us in protective custody."

The question of FPC regulation of gas producers came to a climax in the Supreme Court's Phillips case decision only last June, but the first moves in this direction actually date back to 1940. Two years after the Natural Gas Act became law, the FPC heard a case involving Columbian Fuel Corp. but decided it had no authority to regulate field prices of independent producers.

In 1942, the Supreme Court, in an appeal from FPC proceedings involving Natural Gas Pipeline Co., held the commission had virtually unlimited rate-fixing power within its jurisdiction and was not required to use a particular formula. Three years later, in the Colorado Interstate Gas Co. case, the high court ruled prices for pipeline-owned reserves could be set by the usual public-utility formula, and in 1947, this doctrine was broadened to include gas reserves of a producing affiliate of an interstate transmission company, specifically Interstate Natural Gas Co.

The next important decision in the legal history of FPC producer regulation was in 1949 when, in a setback for the commission, the Supreme Court decided that an interstate transmission company could not be prevented by the commission from selling its produc-

"Among the possibilities raised by federal regulation of production is that of the royalty interests electing to take their production in kind and negotiating a separate contract apart from the regulated price received by the producer."

Natural-Gas Utility Sales (A.G.A. Data)

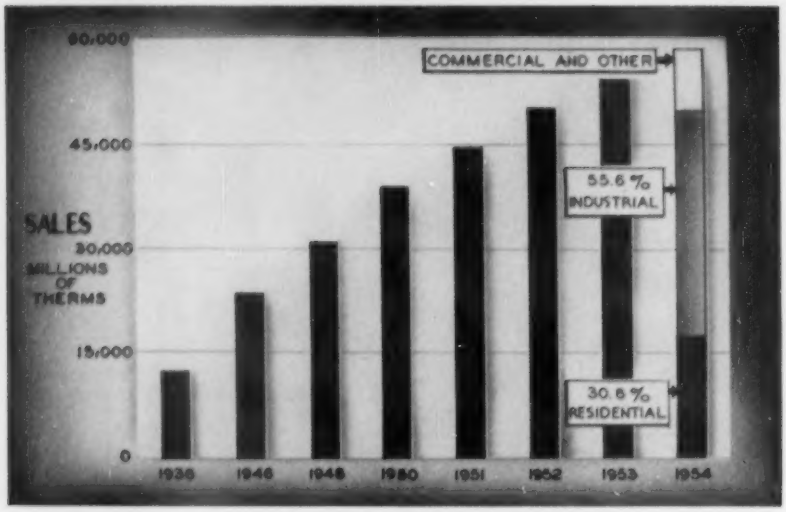


Fig. 7.

ing properties. This involved Panhandle Eastern Pipe Line Co.

The confusion caused by the Interstate Natural Gas Co. case caused the FPC in August 1947 to issue a statement of policy asserting that the Natural Gas Act would not apply to arm's length sales by independent producers and gatherers. However, to pin down this exemption in the law, an exemption bill sponsored by Senator Kerr of Oklahoma was introduced in Congress and passed but vetoed by President Truman. The veto of the Kerr bill was followed in July 1950 by the FPC's formal withdrawal of its previous producer-exemption policy statement as "inconsistent with the requirements of the Natural Gas Act."

Stage was set . . . Thus, the stage was set for proceeding against Phillips to determine whether it was a natural-gas company as defined in the 1938 law. After a prolonged hearing, the commission held by a four-to-one vote that the company was not subject to regulation. When this ruling was taken on appeal by regulatory agencies of northern consuming states, the Court of Appeals reversed the majority FPC decision. In February 1954, the Supreme Court held that the gas sold by Phillips case was in interstate commerce and hence could not constitutionally be taxed by the State of Texas. This decision foreshadowed the final adverse outcome of the FPC jurisdictional case against Phillips.

Not many oil men realize that the natural-gas business—whose future is at stake in the action Congress takes on the regulatory issue—actually is older than the oil-producing industry itself.

What is now ranked as the sixth largest industry in the country in terms of total investment had its origin in 1821 in Fredonia, N. Y., 40 miles from Buffalo. One of the villagers drilled a 27-ft. hole, ran in a piece of lead pipe and used a series of hollow logs to transport natural gas a short distance to the Fredonia Inn. Several crude pipelines of this type were in use prior to Colonel Drake's discovery of oil in western Pennsylvania in 1859. In the 1840's, gas was being used to evaporate brine to produce salt.

Throughout much of the history of the oil business, natural gas was strictly a byproduct to oil production. Pipeline technology was not far enough advanced to move the fuel to important markets, and a gas discovery was usually classified as little better than a dry hole.

Some use was made of the fuel in short lines. Then, in 1870, the first "long distance" transmission line was made of 8-in. holes bored in white-pine logs. It cost about $1,500,000 when it was built to carry natural gas about 25 miles to Rochester, N. Y. The project failed after 2 years.

Iron pipe came in about 1872. In that year, a 2-in., 5½-mile line was laid to Titusville, Pa., and delivered about 4 million cubic feet daily to domestic and industrial consumers. The country's first high-pressure line, with a working pressure of 525 psi., was built in 1891 from northern Indiana to Chicago. It was 8-in., extending 120 miles.

Shifts to west . . . It was not until the twenties that the main gas-producing area shifted from the Appalachians and upper New York to Texas and California. In 1900, for example, total production of natural gas was valued at less than $25,000,000, and Pennsylvania was the largest producing state. Even as late as 1925, there were only about 3½ million customers receiving natural gas and these were located within a few hundred miles of the producing fields.

Although basic economic considerations—cheap, abundant supply at one end and heavy demand at the other—promoted the great wave of expansion of the transmission industry beginning in the forties, this growth was made possible only by improved engineering in pipe, construction methods, and compressor design.

In 1925 seamless, electrically welded pipe became available to the industry, and in the following 5 years, consumption rose to 1.9 trillion cubic feet. Pipe able to withstand higher and higher pressure was being provided, and compressors became more efficient. In fact, the conditions for great growth of the transmission business existed in the early thirties, but the depression and economic conditions prior to the war limited its growth.

The advent of large-diameter pipe and its effect is shown in the accompanying Table 2. These and similar

"Oil men insist that the likelihood that federal regulation would drive gas production into intrastate markets is more than an idle threat . . . There is a large potential outlet in new industrial plants and petrochemical facilities."

Natural Gas . . . Natural-Gas Pipelines

TABLE 2—DATA ON AN OLD AND A MODERN PIPELINE

	Memphis	California
Year built—	1928	1947
Pipe:		
Type	Lapweld	Electric-weld
Diameter, in.	18	30
Thickness, in.	11/32	11/32
Steel:		
Yield point, psi.	25,000	52,000
Max. hoop stress, psi.	10,500	35,000
Max. line pressure, psi.	400	800
Length in miles	211	214
Capacity with two stations, M.M.c.f.d.	60	430

From a paper by Lyon F. Terry, Chase Manhattan National Bank.

Natural Gas . . . Natural-Gas Pipelines

technical developments greatly reduced the cost of transporting natural gas over long distances. The knotty load-factor problem was met by developing large-scale underground storage near the point of consumption.

One index of the present stature of the natural-gas industry is its percentage contribution to the total energy supply of the country. This has shown a consistent rise since 1938, and natural gas now meets roughly 25 per cent of total energy requirements. Significantly, total energy consumed has shown a gradual decline since the boom period of 1951, but natural gas has continued its upward trend, rising to 9.353 trillion B.t.u. in 1954 from 9.057 the previous year.

At the same time, total miles of natural-gas pipelines in service have continued to increase (Fig. 5). A.G.A. figures show a total of 413,300 miles of natural-gas lines at the end of 1954. This compares with 393,890 at the end of 1953, a gain of 4.9 per cent. Of the year-end 1954 total, 268,000 miles was in distribution, that is, city gas mains. The transmission segment accounted for 131,650 miles, and the remaining 43,500 miles was in field and gathering systems. Total miles of natural-gas transmission in 1945 amounted to 77,280. The gain since that time has amounted to 83 per cent.

Future growth . . . The A.G.A. statistical department, headed by Dan Parsons, has carried out several studies on likely future growth of the natural-gas and gas utility industry. The projections are based on questionnaires to the operating companies. The following table summarizes sales and year-end customers. The figures are for the entire gas utility industry but they particularly reflect anticipated growth of natural gas since the other two types, mixed with manufactured, make up only a relatively small part of the entire industry.

An earlier study of the A.G.A. gave an indication of what this possible future growth means in terms of requirements for materials. Total steel-pipe requirements of the gas-utility and pipeline industry in the period 1954-57 were placed at 4,642,000 tons, and other steel requirements at 134,000 tons, for a total of 4,776,000 tons. Cast-iron requirements were estimated at 446,000 tons in the same period, copper at 8,589 tons and aluminum at 502 tons.

The A.G.A. estimate of total industry expenditures for construction in 1955 was 1,395 million dollars. This compares to 1,108 million in 1954, and 1,350 million in 1953. The record year was 1951 when the total outlay amounted to 1,462 million dollars.

Natural-Gas Utility Revenue (A.G.A. Data)

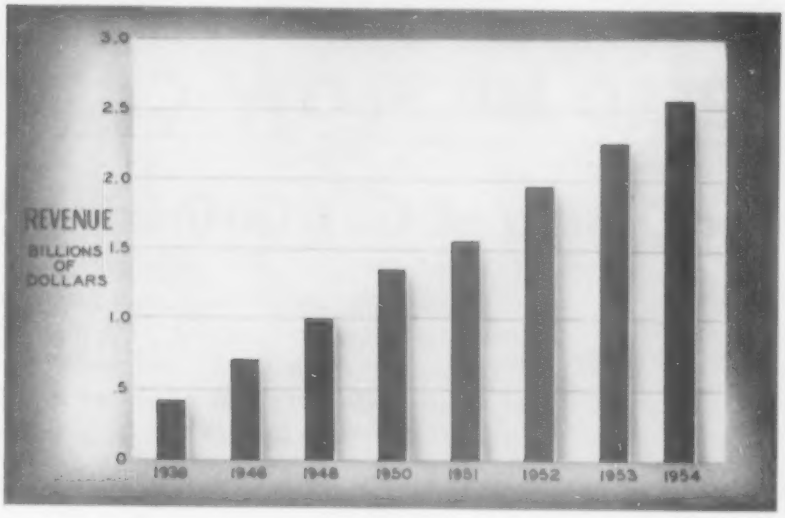


Fig. 8.

SALES—ALL CLASSES
(In billions of therms)

1953	56,467
1954	61,012
1955	65,025
1956	68,800
1957	71,325

YEAR-END CUSTOMERS—ALL CLASSES

1953	27,250
1954	28,050
1955	28,900
1956	29,800
1957	30,600

In 1954, for the fifth successive year, more than 1 billion dollars was spent by the gas utility and pipeline industry on new facilities and expansion. If the $1,400,000,000 estimated expenditures in 1955 is realized, this year will be the second largest in gas-industry construction.

The heavy expenditures for 1955 reflect the start of work on two new long-distance transmission lines. Temporary certification has been granted by the FPC for construction of American Louisiana Pipeline Co.'s 1,200-mile trunk from Texas to Michigan. This 30-in. line will cost $130,000,000. Similar FPC approval has been given to the Pacific Northwest Pipeline Co. to build its 1,800-mile line from the San Juan basin in Colorado and New Mexico to the Pacific Northwest. Estimated cost of this project is around $160,000,000.

Pace is slowing . . . Although the natural-gas utility industry is continuing to make good year-to-year gains, there is some slight evidence of a slackening in its rate of growth. This was apparent even before the long-term future of gas supplies was made uncertain by resistance to producer regulation resulting from the Phillips decision.

The slight slowdown in the expansion rate shows up in the three most widely used indexes prepared by the A.G.A. These deal with total utility customers, sales of utility gas, and gas-utility revenues.

Last year natural-gas utility sales reached the new peak at 57,617 million therms. The gain over 1953 was 8.3 per cent. In 1953, the increase was 8.4 per cent; and in 1952, 9.7 per cent.

Weather conditions during the winter months, of course, severely affect total gas sales. However, a decline in the rate of increase also is apparent in the number of customers. The 20,893,000 customers receiving natural gas at the end of 1954 (Chart 6 is based on average customers during the year) represented an increase of 5.4 per cent. In 1953, year-end customers were up 6.8 per cent; in 1952, 14.5 per cent.

Revenue of gas utility companies in 1954 totaled $2,561,815,000, up 13.4 per cent. This was bigger dollar-wise than 1953's increase of 14.8 per cent. However, in 1952, the gain in revenue was 17.2 per cent. Of total revenue last year, 55 per cent came from residential customers who received 30.8 per cent of the total gas sold. On the other hand, industrial customers who contributed 30.4 per cent of total revenue, received nearly 56 per cent of the gas sold.

Use these charts to

SPEED UP FLOW CALCULATIONS

For Design of Gas-Gathering Systems

Here, in one complete package, is a simple, accurate method of making gas-flow calculations. The method applies equally well to both transmission lines and gathering though only the latter are covered here. Its use gives an EXACT solution to the general flow equation of the U. S. Bureau of Standards Monograph 6. Yet the method can be used as rapidly as more specialized formulas. Also included are general factors to consider in gas-gathering-system design plus a sample solution to a typical design problem.

by Ovid Baker and Will Swerdloff

MANY excellent articles have been published concerning the factors entering into the design of long-distance gas-transmission pipelines.[1 2 3 4 5] Design of pipelines for gathering natural gas in the oil field has not received as much study.

The "General Flow Formula" developed by the Bureau of Standards in Monograph 6[6] is the most accurate method of designing gas pipelines. However, this formula is not always convenient to use. Other specialized formulas, such as the Weymouth, Panhandle, Oliphant, and Spitzglass have been developed for certain types of gas-pipeline designs and are accurate within the range for which they were intended. When used outside this intended range, they sometimes give undesirable designs. This article presents the general flow equation in a form where it may be used as rapidly as the more specialized equations and yet retain its accuracy under all conditions.

Although the methods presented apply equally to transmission and gathering lines, their use will be illustrated by a discussion of gathering-system design.

Development of Formulas

The general flow equation is:

$$Q = \frac{KT_b}{1{,}000\,P_b}(P_1^2 - P_2^2)^{1/2}\frac{1}{(L')^{1/2}}d^{2.5}\frac{1}{(f)^{1/2}} \times \frac{1}{(S)^{1/2}}\frac{1}{(T)^{1/2}}\frac{1}{(Z)^{1/2}}(LF) \qquad (1)$$

Where:

- Q = M.s.c.f.d. of gas flowing (thousands of standard cubic feet of gas per 24-hour day)
- K = constant = 38.7744
- T_b = standard base temperature, °R. = °F. + 460 (usually 60° F. + 460 = 520° R.)
- P_1 = initial pressure of gas at pipeline inlet, psia.
- P_2 = final pressure of gas at pipeline outlet, psia.
- L' = length of pipeline, miles
- d = pipe diameter, in. (i.d.)
- f = Fanning friction factor
- S = specific gravity of gas flowing (air = 1)
- T = temperature of gas flowing, °F. + 460
- Z = compressibility factor of gas at flowing conditions
- LF = load factor to take care of fluctuations from the average gas-flow rate. Usually taken as 0.75 for main lines and 0.50 for lateral gathering lines.

The above equation has been regrouped into the following form:

$$d = \left(\frac{QP_b\,S^{1/2}\,T^{1/2}\,L^{1/2}\,f^{1/2}\,Z^{1/2} \times 1{,}000}{KT_b\,(P_1^2 - P_2^2)^{1/2}\,(LF)}\right)^{1/2.5} \qquad (2)$$

The equation has been simplified as follows:

$$d = MOBILGAS \qquad (3)$$

Where:

- $M = [(Q/K)\,(P_b \times 1{,}000)/(T_b)]^{1/2.5} = 0.88$ (M.c.f.d.)$^{0.4}$ when the temperature base is 60° F. and the pressure base is 14.65 psia.
- $O = 0.18\,(L)^{0.2}$, where L is in feet
- $B = \frac{1}{(P_1^2 - P_2^2)^{0.2}}$
- $I = (f)^{0.2}$
- $L = (S)^{0.2}$
- $G = (460 + °F.)^{0.2}$
- $A = (1/LF)^{0.4}$
- $S = (Z)^{0.2}$

Each of the terms in Equation 3 may be read from Figs. 1 through 8.

When designing a gas-gathering system this formula

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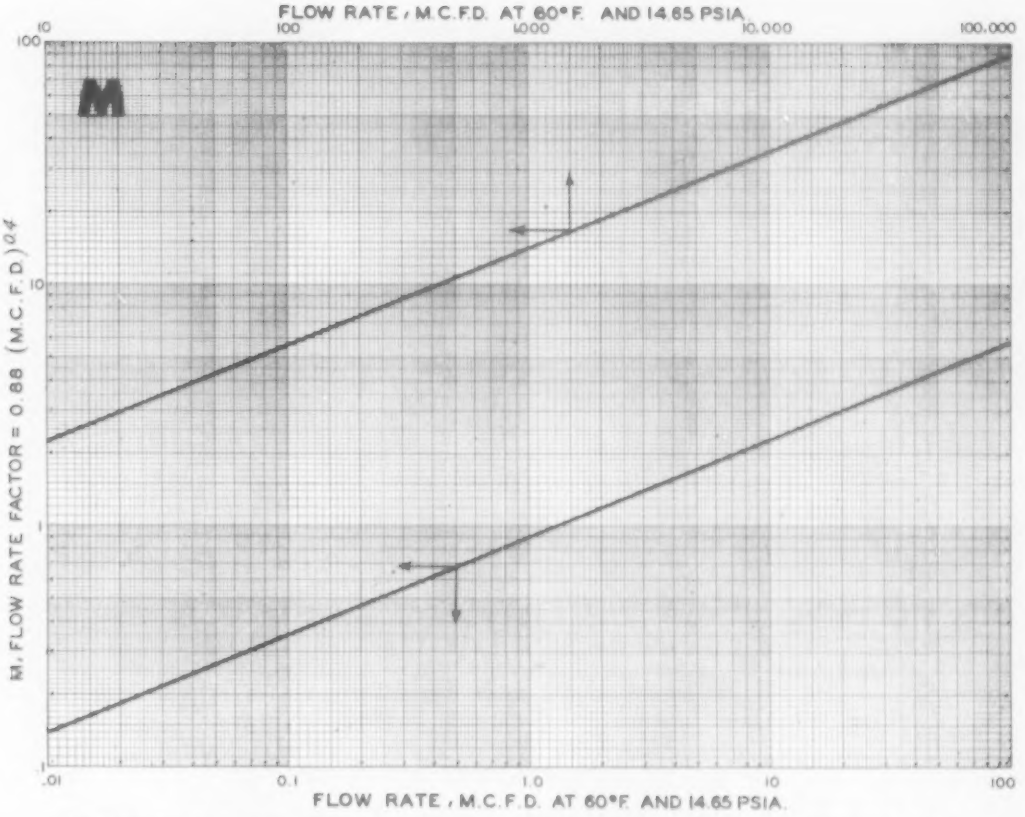
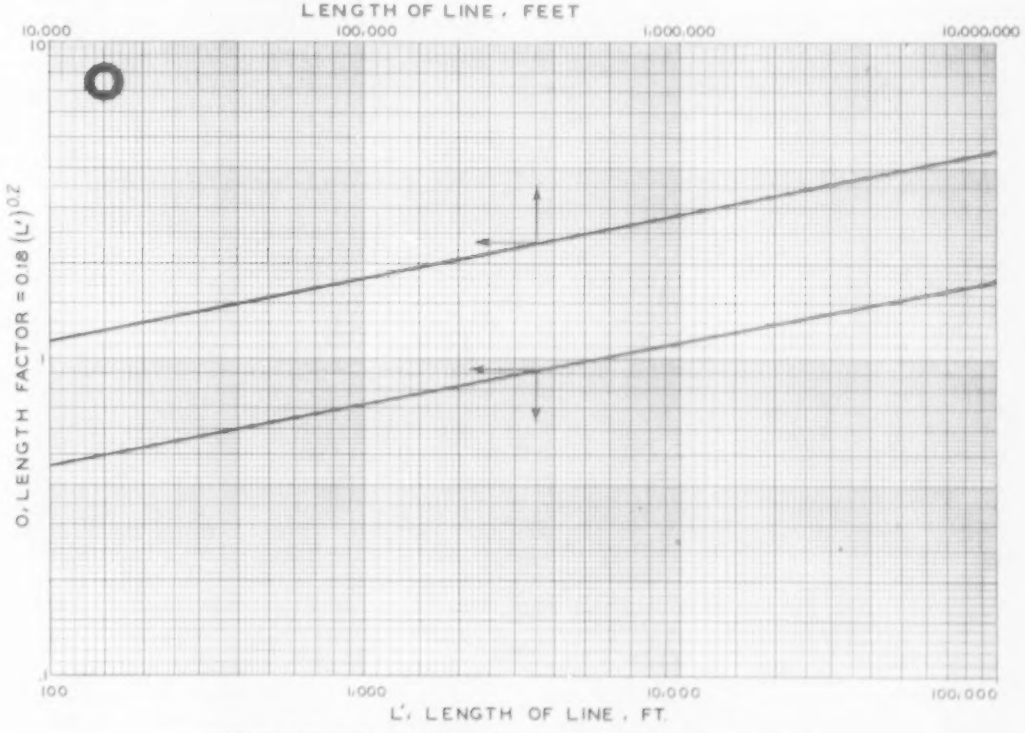
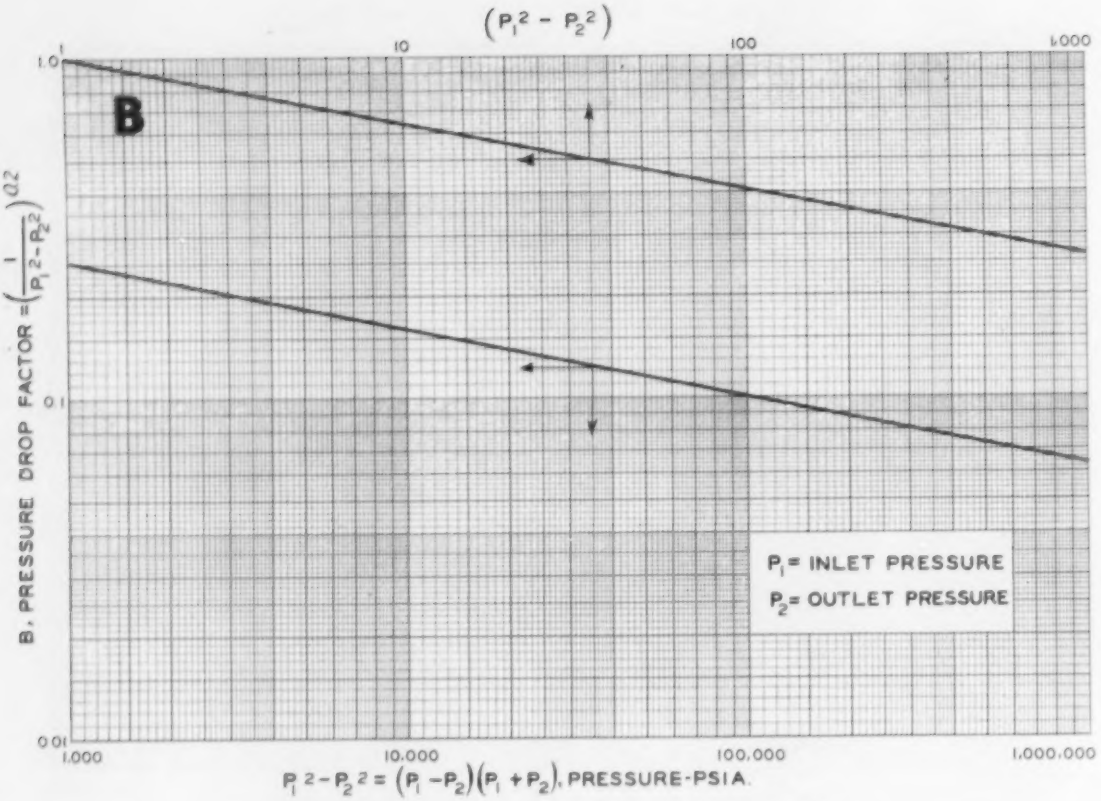


VALUES OF M, flow rate factor, versus flow rate. To be used with Equation 3, d = MOBIL GAS. Fig. 1.



VALUES OF O, line length factor, to be used with Equation 3. Fig. 2.



VALUES OF B, pressure drop factor, to be used with Equation 3. Fig. 3.

Natural Gas . . . Natural-Gas Pipelines

can be used very profitably for a quick estimate of the pipe diameter in each branch of the gathering system. The choice of conditions for making the first estimate of gathering system diameters is discussed below:

Gas volume . . . This is the average daily gas volume flowing through the particular section of pipe being sized and should be used in Fig. 1. Often preliminary gathering system designs must be made for economic studies before the field development is complete. In this case true gas volumes will be unknown.

Sometimes estimates of the volume per well, well spacing, and areal extent of the field will be available from the reservoir engineers. Consideration should also be given to variation in gas production as the field develops and declines. An excellent discussion of these factors is given by W. F. Matheny in his paper "Management Considerations for Gasoline-Plant Design."[7]

When this estimate is completed the designer will have a map of the field showing actual or probable well locations and the design gas volume posted beside each well.

Length of line . . . The next item in the design of the gathering system is to locate the gasoline plant or delivery point for the gathering system and make a layout of the main lines and laterals.

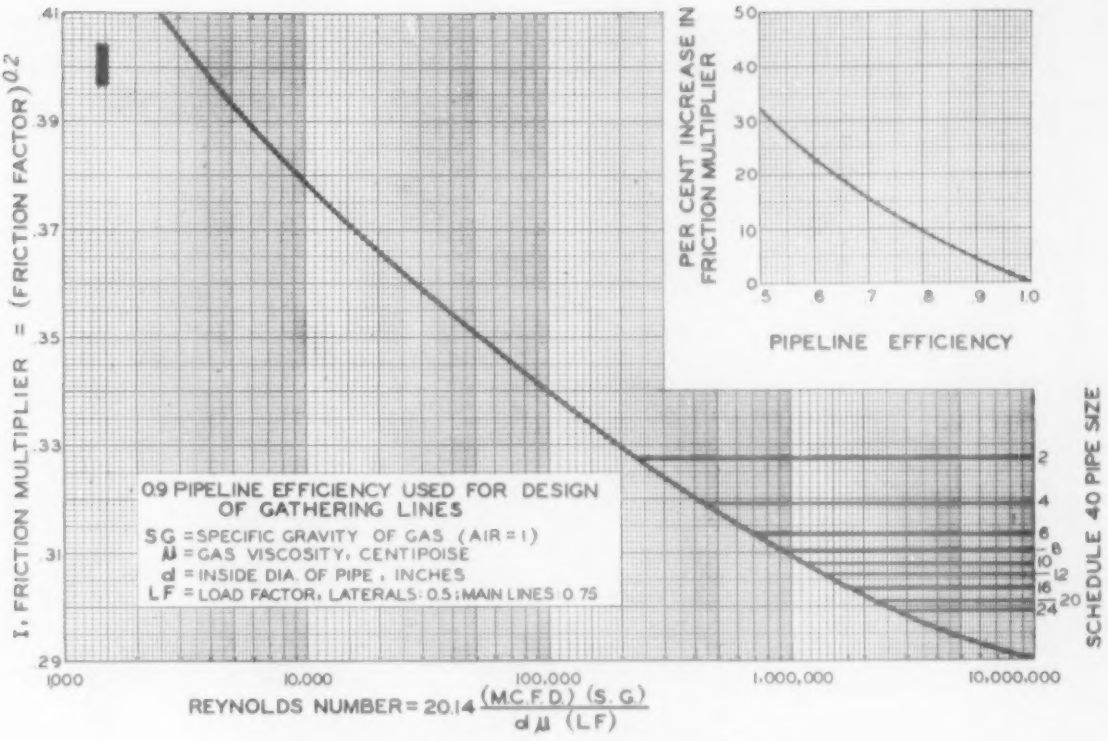
Each section of line between connections with other lines or wells should be numbered. The length of each section is used in Fig. 2 in solving for the diameter of that section of line. These distances may be conveniently scaled from the map. Large savings in investment in gathering system will result from a careful layout.

It is usually helpful to sketch lightly on the map the main lines leading from groups of wells toward the plant. These lines should be used for general guides only and the designer should start from the edge of the field, working in toward the gasoline plant in the center. In general the gas should never flow away from the plant.

It is suggested that the articles on "Economical Alignments for Pipelines"[8,9,10] be studied. These methods may seem complex, but when they are made up in graphical form they can be used very rapidly. Savings of 10 to 20 per cent in the cost of gathering lines are possible by following the suggestions in these articles. Since gathering-system costs range from $100,000 to $4,000,000[11] these savings justify careful work when planning the routes of the pipelines.

If the gas line also carries some condensate in the liquid phase it may be well to try laying out the lines so flow is always downhill toward the plant. This will prevent added pressure drop due to the accumulation of liquid where the line starts up hill. This old rule of following the creeks has been used for crude-oil gathering systems for many years. Some of the problems involved are discussed in the article "Surveys for Field Gathering Lines," by Peyton Bryan.[12]

Operating pressures . . . These are the inlet and outlet pressures for each section of line and are used in Fig. 3. The average operating pressure of the pipeline will be determined by the type of gas being handled.



FRICTION FACTOR multiplier, I, for Equation 3. Fig. 4.

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Systems gathering gas from oil production will ordinarily operate near atmospheric pressure. Gas-field gathering lines with practically no condensate may operate in the range of 200 to 500 psia. Condensate-field gathering lines usually operate in the range of 800 to 3,000 psia. and field lines leading to injection wells operate in the range from 3,000 to 5,000 psia.

Casing-head-gasoline plants often operate with atmospheric pressure at the plant inlet so that a slight positive pressure is always on the gathering lines. Having positive pressure is most desirable in sour-gas fields where air leaking into the pipe causes corrosion in both pipelines and plant equipment.

In most cases field-separator pressures are determined by an economic balance between cost of the gathering system and the amount of total liquid hydrocarbons recovered in the oil lease tanks and the gasoline-plant product tanks. Lower separator pressures will increase gasoline-plant liquid production. But they may double investment in the gathering systems. Studies of optimum separator pressure are often made by reservoir engineers before the gathering lines are designed.

TABLE 1—APPROXIMATE PRESSURE DROP IN GAS-GATHERING LINES, PSI. PER 1,000 FT. OF LENTH IN SECTION

Avg. pipeline operating press., psia.	Distance from plant to most remote well (ft.)			
	5,000	10,000	40,000	100,000
12	0.5- 0.7	0.25- 0.4	0.09-0.15	
25	0.9- 1.1	0.45- 0.65	0.15-0.25	
250	3.7- 5.5	2.0 - 3.0	0.7 -1.0	0.3-0.5
1,000	9.5-14.5	5.5 - 8.2	1.7 -2.6	0.8-1.2
4,000	25.0-37.0	14.0 -20.0	4.0 -7.0	

Examples of this type of study are given in References 13 and 14. A discussion of these and related factors may be found in "Problems in Producing and Gathering Low-Pressure Gas," by C. L. Ritter.[15]

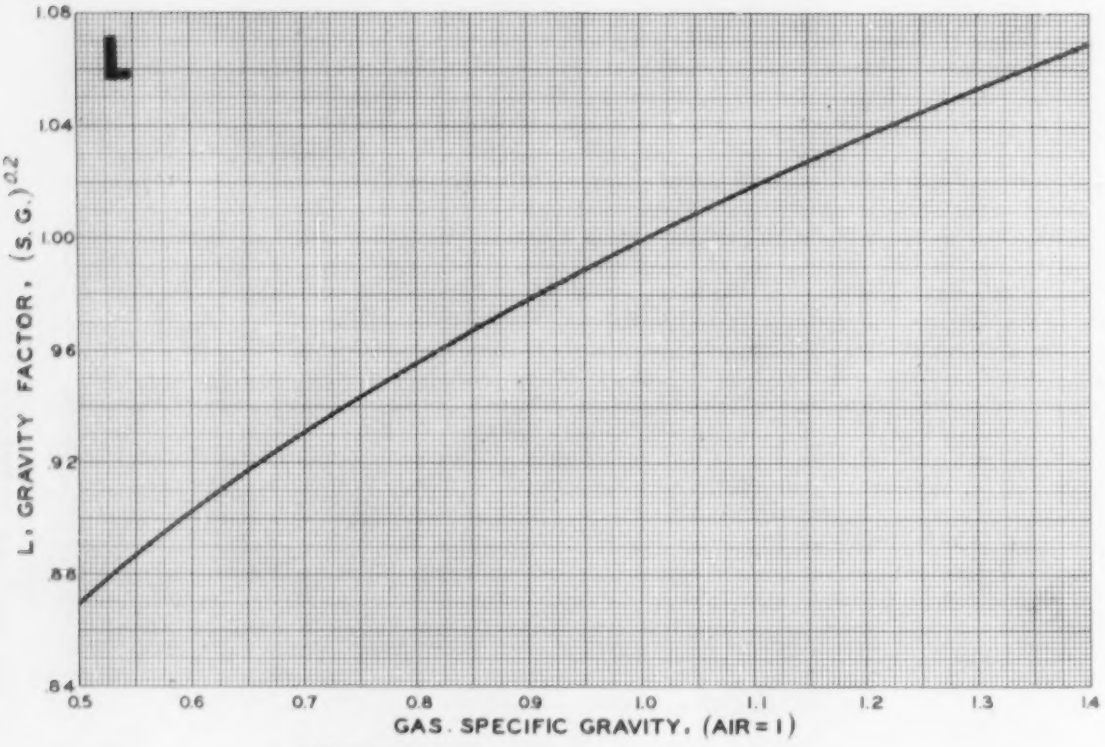
Pressure drop in the gathering system may ultimately be decided by the economic studies mentioned above. But the designer must make some initial assumptions. A large number of gathering-system designs have been studied to provide a guide. Table 1 gives a first estimate of the pressure drop per thousand feet of pipe for gathering systems at various operating pressures and lengths.

It should always be kept in mind that operating pressure that will be satisfactory when the field is new may have to be lowered as the field becomes older. It is usually worth while to consider the predicted volume of gas production and the predicted separator pressures over the entire life of the field before making a final decision. When using the data from Table 1, the pressure drop should be increased slightly for the sections of the line near the outer edge of the field and decreased slightly for the sections nearest the plant.

Using the data in Table 1, the pressures at the inlet and outlet of each section on the line from the plant to the most remote well can be posted on the map. It usually will be possible to increase the pressure drop per thousand feet on the branches off this line. Pressure drops of 0.25 to 0.5 psi. are necessary at both field separator and plant entry metering stations. These drops should be included.

Friction factor . . . Friction factors are dependent on Reynolds number and the roughness of the inside of the pipe. Fig. 4 gives friction multipliers for use in Equation 3, d = MOBILGAS. These multipliers are for smooth, clean, steel pipe.

As gas pipelines become older there will be an in-



GAS GRAVITY factor, L, to be used with Equation 3. Fig. 5.

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creased pressure drop due to the accumulation of liquids and dust in the line and due to internal corrosion. The insert chart in Fig. 4 shows the percentage increase in the friction multiplier as a function of pipeline efficiency. An efficiency of 0.9 is recommended for design purposes. For the preliminary sizing of the pipeline, an average friction multiplier may be assumed to hold throughout the system.

In using Fig. 4 it is necessary to assume a value of the pipe diameter for the section being designed. When the pipe diameter is solved with Equation 3 the new diameter can be substituted into Fig. 4 and a simple correction made.

Numerical values of the friction factor, taking into account various degrees of roughness, have been discussed exhaustively in References 17 through 27.

After considering the many points of view discussed, the friction factors proposed by R. V. Smith et al.[17] have been adopted. Smith's friction factors are based on the Nikuradse equation with an absolute roughness value of 0.00065 in. for clean commercial steel pipe in hydrocarbon service. These friction factors expressed as "transmission factors" are shown in Fig. 10.

For purposes of comparison, friction values from operating long-distance transmission pipelines carrying oil or natural gas have been plotted on the transmission factor chart. The size of pipe for each point is indicated. These indicated points are limited to pipelines carrying either gas or oil, both of which are relatively clean and noncorrosive fluids.

It will be noted that many of the pipelines are operating at 100 per cent efficiency. If the individual points are studied it will be seen that none of these pipelines are operating at a transmission factor value of less than 0.9 of the values indicated by the curve. It is usually considered economical to run scrapers through high-pressure gas-transmission lines to maintain the design friction factor.[16] Most of the pipelines which are operating at 100 per cent efficiency have excellent scraper programs to maintain the pipe in a smooth condition.

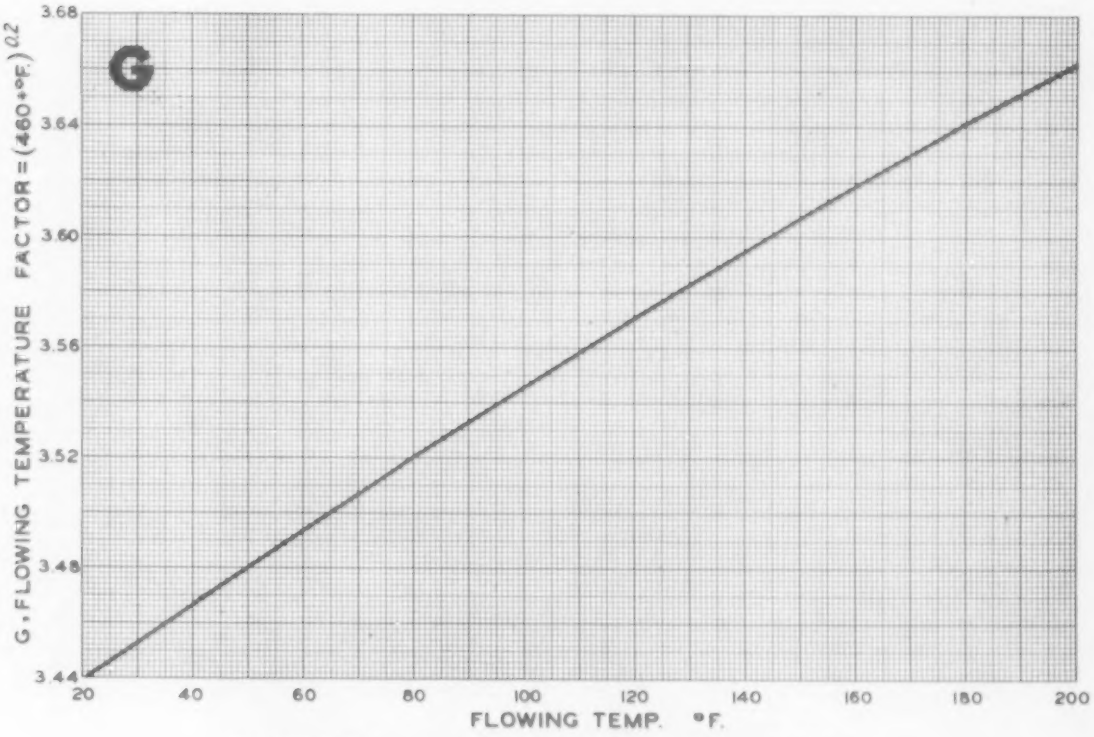
Since scrapers ordinarily are not run through gathering lines it will not be possible to maintain their friction factors at the favorable values obtained in long gas-transmission lines.

Efficiency of pipelines in gas-gathering systems is decreased about 3 per cent for pipe smaller than 12 in. and about 6 per cent for pipe larger than 20 in. due to the many lateral connections and valves in the system. The efficiency may be decreased further by solid particles adhering to the inside wall of the pipe. These dust particles may be carried out of the pro-

TABLE 2—EFFECT OF LIQUID IN PIPELINE ON TRANSMISSION EFFICIENCY

Liquid flowing in line (gal./M.M.c.f.)	Efficiency for gas flow	Type line
0.1*	0.92	Dry-gas-field gathering line.
7.2	0.77	Casing-head-gas gathering line. Field separators with liquid carryover at maximum values.
800	0.60	Gas and condensate gathering line.
9,000	0.31	Casing-head gas and crude-oil two-phase gathering line.
52,000	0.04	Casing-head gas and crude-oil two-phase gathering line.

*Estimated.



GAS FLOWING temperature factor, G, to be used with Equation 3. Fig. 6.

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ducing formation into the line, may have gotten into the line during construction, or may be scale particles formed by corrosive materials in the gas.

If the gas contains some liquid flowing along with it there will be an additional pressure drop caused by the liquid. Some data showing the effect of the amount of liquid flowing in the line on efficiency is given in Table 2. These data are from operating pipelines, gathering natural gas.

The importance of effective liquid entrainment removal devices in field separators is emphasized by the data in Table 2. At present many engineers specify that field separators reduce the liquid entrainment in the gas to 1 gal. per M.M.c.f. A pipeline efficiency of 83 per cent would be expected with this kind of separator. Pipeline efficiency of 92 per cent would be expected if the mist extractor were specified to reduce the entrained liquid to 0.1 gal. per M.M.c.f. It is usually possible to check the amount of liquid carryover into the pipeline system by measuring the amount of liquid removed annually from the pipeline drips and inlet separators at the gasoline plant.

If there is a large amount of liquid flowing along with the gas it is suggested that the procedure outlined in this article, "Designing Pipelines for Simultaneous Flow of Oil and Gas,"[28] should be used instead of the efficiency shown in Table 2.

It is recommended that a pipeline efficiency of 0.9 be used for design of transmission lines which do not use scrapers. Gathering lines handling noncorrosive gas and having good field separation of liquid mist may be designed for 0.9 efficiency. If the gas contains corrosive substances and if there is considerable liquid carryover into the pipelines, it is suggested that an efficiency of 0.75 be used.

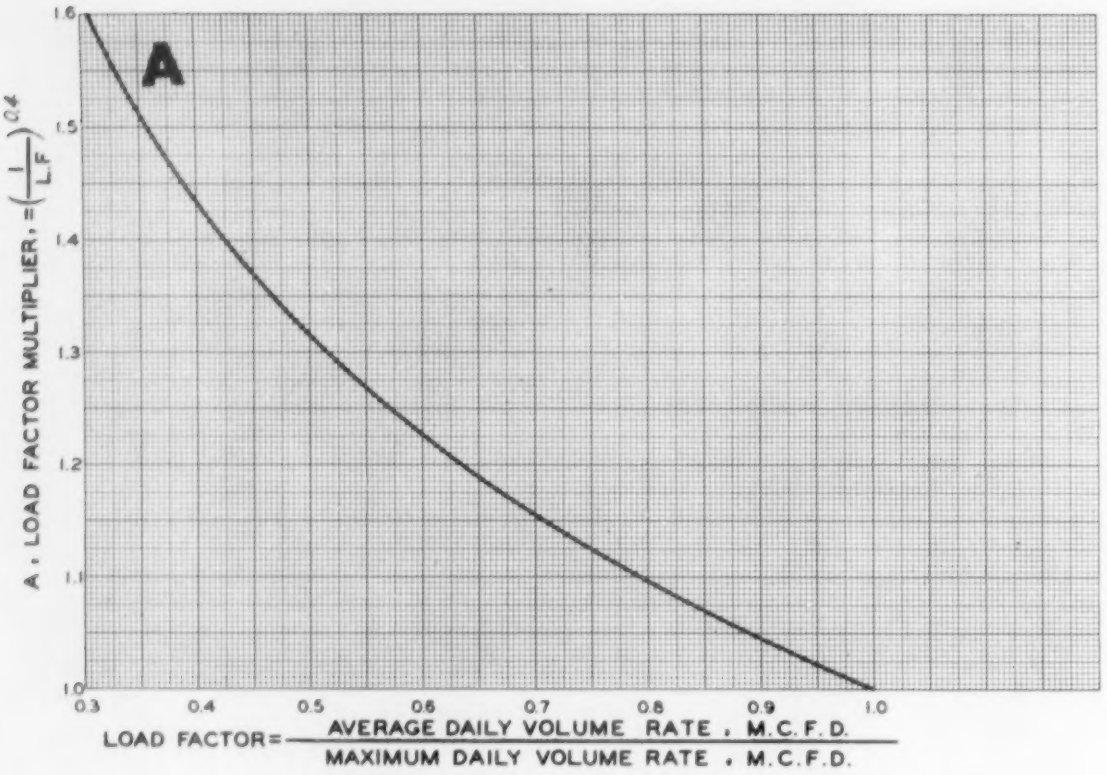
It should be realized in comparing values of pipeline efficiency that the above efficiencies are based on the friction factors of R. V. Smith et al.[17] as 100 per cent. They are not comparable to other efficiencies reported in the literature until those efficiencies are recalculated on the basis of Smith's friction factors.

Gas specific gravity . . . The factor for gas specific gravity is shown in Fig. 5. Specific gravity will depend on the gallons of propane and heavier vapor in each thousand cubic feet of the gas. The content will depend on the separator pressure and temperature chosen. This information usually is in the reservoir engineer's report or can be calculated from the gas analysis.

Flowing temperature . . . The flowing temperature factor is shown in Fig. 6. The temperature of the gas in the pipeline may vary widely depending on its source and on the temperature of the ground through which it flows. If a substantial pressure drop is taken through a regulator before entering the pipeline the gas may cool down to a low temperature. At summer conditions the soil will warm the gas but in the winter the gas may arrive at the plant at an unexpectedly low temperature, causing difficulties with plant operation.

In some cases compressed gas is discharged to the pipeline without cooling and a rather high temperature may be found in the line. Usually the gas is cooled by the ground in a mile or so. Since ground temperature at pipeline depth determines the flowing temperature of gas in most pipelines, it is worth while to investigate the underground temperatures in an area where the pipelines are to be laid. A rough guide to these temperatures is given in Table 3.

Some additional data on minimum ground tempera-



LOAD FACTOR, A, to be used with Equation 3. Fig. 7.

Natural Gas . . . Natural-Gas Pipelines

tures in Texas and Louisiana are given in Reference 29 as well as a method of predicting the heat loss from the flowing gas to the earth. This problem is also discussed in Reference 30.

TABLE 3—VARIATION IN SOIL TEMPERATURES* 3 FT. BELOW THE SURFACE, °F.

Location—	January	April	July
Massachusetts	36	42	60
Ottawa, Canada	37	34	62
Michigan	38	43	60
Montana	33	34	54
Washington	37	44	61
Illinois	41	46	66
Nebraska	38	43	68
Wyoming	26	37	65
Idaho	37	40	56
Kentucky	40	50	70
Missouri		51	77
Colorado (Plains)	35	44	65
Alabama	51	61	79
Mississippi	57	70	80
Texas (Panhandle)	42	55	75
Texas (North)	47	62	79
Texas (Central)	60	64	80
Texas (South)	62	66	80
Oklahoma	48	60	78
California	51	60	81

*Soil temperature depends on the conductivity and thermal diffusivity of the soil as well as the monthly mean surface temperature. Rocky soil is more conductive than fine soils.

Load factor . . . The load factor is equal to the average daily volume rate divided by maximum daily volume rate. The design volume of gas used in Fig. 1 is the average daily volume. The load factor takes into account the fact that gas is not produced from each well at the average rate.

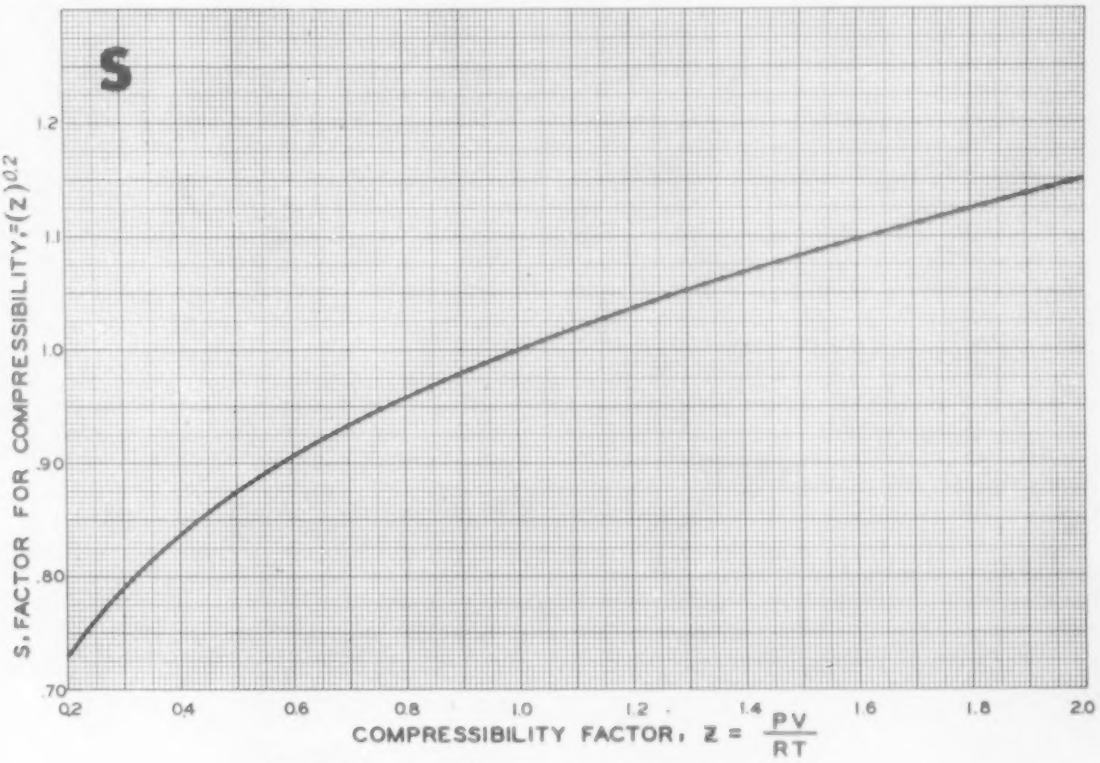
For casing-head-gas gathering systems the usual design load factors are 0.5 for lateral lines and 0.75 for the main lines. For condensate-field production some designers have used load factors as high as 0.9. The load factor may be increased in fields having many wells by scheduling production periods for the well to maintain as near a constant flow as possible in the main lines. Load factor corrections are given in Fig. 7.

When scheduling is not used the lease pumpers will tend to produce the wells at times most convenient to them. And they will produce their allowable in the first part of the month to be sure they get it all in.

Gas volumes arriving at the gasoline plant will start increasing about 7 a.m., reach a maximum at 10 a.m. and drop down somewhat at noon. Volumes will pick up again around 1 p.m., reach a maximum around 3:30 p.m., and drop off again. The gas volume versus time curve shows remarkable dips during the time of a World Series broadcast. In a large field with many wells, scheduling sometimes becomes a difficult problem for the gasoline-plant operator.

Compressibility factor . . . The last term in Equation 3, "S," the effect of compressibility factor, is found in Fig. 8. Compressibility factors for natural gases may be found in the Natural Gasoline Supply Men's Handbook[31] and in the book "Line Pipe."[32]

Pipe diameters . . . Usually a tabulation is made listing



FACTOR for compressibility, S, to be used with Equation 3. Fig. 8.

Natural Gas . . . Natural-Gas Pipelines

the line section number, M.c.f.d. flowing in the section, length of the section, entrance and outlet pressures in psia., terms M, O, B, and I, from Fig. 1 through 4 and a combined factor for the terms "LGAS."

All of these terms in Equation 3 are multiplied together to obtain "d," the calculated inside diameter in inches. The "d" values also are tabulated and the nearest commercially available pipe size written beside it. The effect of the altered diameter on the flow capacity can be readily obtained by using Fig. 1.

Many designers use no pipe smaller than 4-in. for low-pressure gathering systems. Two-in. pipe is sometimes used on high-pressure systems. In most cases it will not be necessary to change the diameter of more than five or six sections of the line when a firm design is made. The list of pipe for purchasing may be taken from the preliminary design tabulation.

Rapid Solution for Flow Capacity

The general flow formula may be regrouped into the following form:

$$Q = 100\ ABCDEFG\ (LF) \qquad (4)$$

$\frac{KT_b(5{,}280)^{1/2}}{1{,}000\ P_b}$ = 100.002 when the temperature base is 60° F., the pressure base is 14.65 psia., and the length of line, L, is expressed in feet.

$$A = (P_1^2 - P_2^2)^{1/2}$$

$$B = 1/(L)^{1/2}, \text{ where L is in feet}$$

$$C = d^{2.5}$$

$$D = 1/(f)^{1/2}, \text{ transmission factor}$$

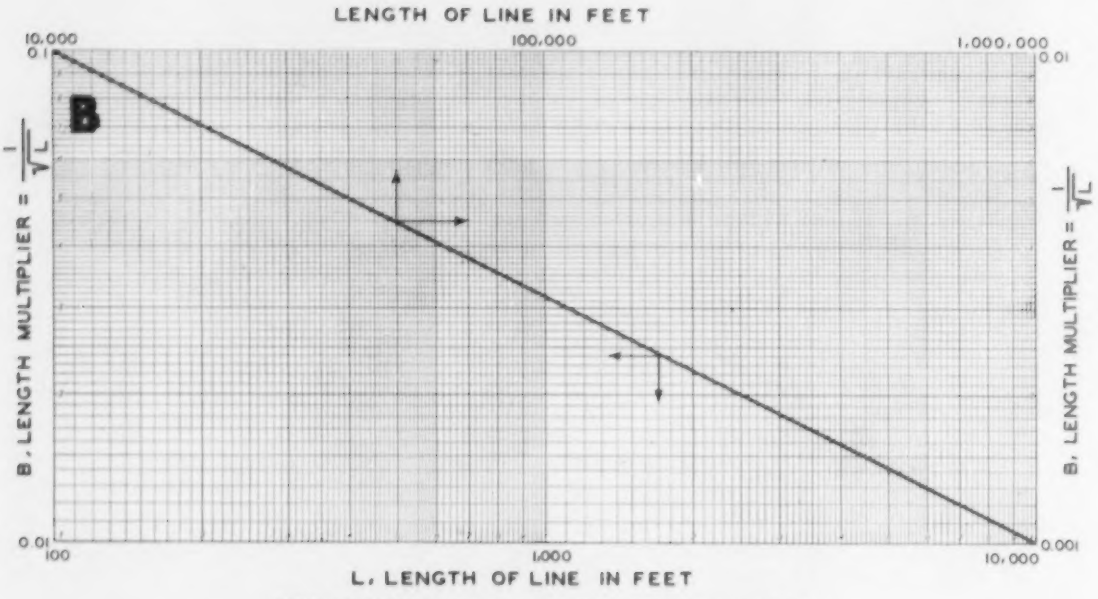
$$E = 1/(S)^{1/2}; \quad F = 1/(T)^{1/2}; \quad G = 1/(Z)^{1/2}$$

$$LF = \text{load factor}$$

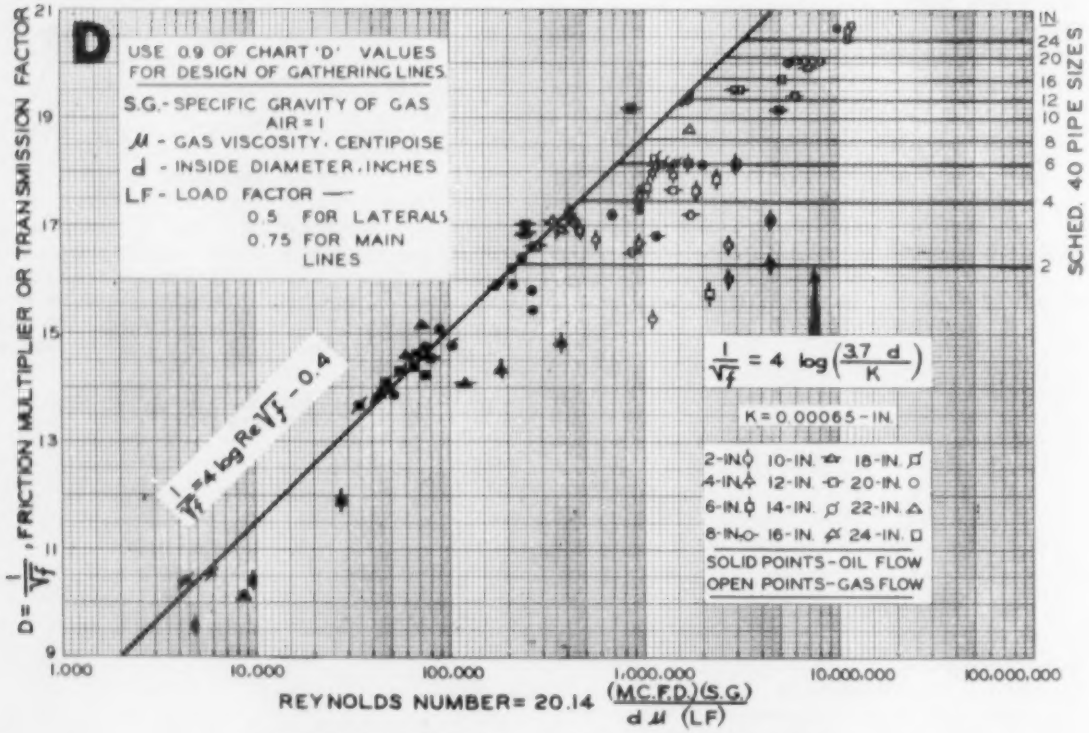
The term "A" is difficult to read accurately enough from charts or tables. It is best obtained using a desk calculator. Square roots of large numbers can often be determined by trial and error on a calculator more rapidly than using more formal methods. The term "B" is obtained from Fig. 9. The term "C" may be

TABLE 4—PIPE-DIAMETER FACTOR, "C," IN EQUATION: Q = 100 ABCDEFG (LF)

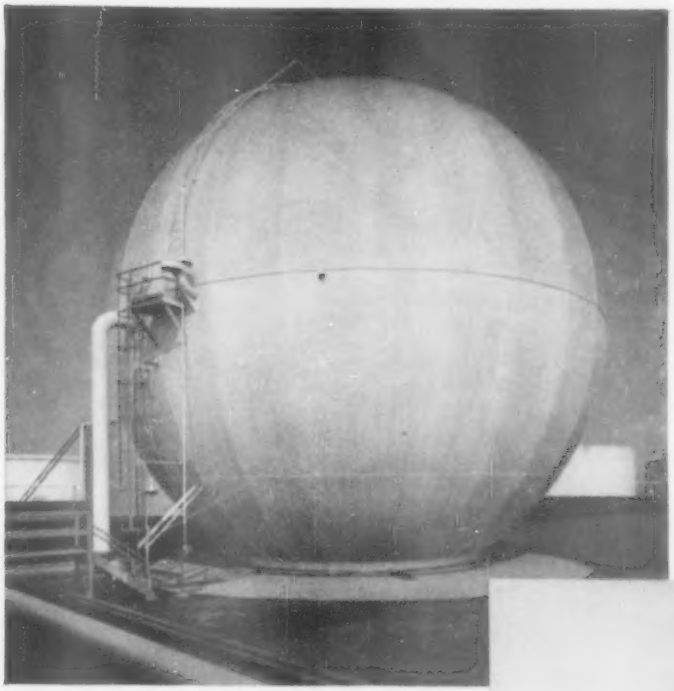
Nominal size (in.)	Actual i.d. (in.)	$C = d^{2.5} = d^2 \times (d)^{1/2}$
4	4.026	32.5
	3.826	28.25
6	6.343	101
6⅝	6.407	104
8	8.343	201
8⅝	8.407	205
10	10.468	356
10¾	10.532	359
12	12.468	550
16	15.656	960
18	17.656	1,309
20	19.656	1,710
22	21.656	2,185
24	23.656	2,722



LINE LENGTH factor, B, to be used with Equation 4. Fig. 9.


D
USE 0.9 OF CHART 'D' VALUES FOR DESIGN OF GATHERING LINES
S.G. - SPECIFIC GRAVITY OF GAS AIR = 1
μ - GAS VISCOSITY, CENTIPOISE
d - INSIDE DIAMETER, INCHES
LF - LOAD FACTOR —
0.5 FOR LATERALS
0.75 FOR MAIN LINES
1/√f = 4 log Re √f - 0.4
1/√f = 4 log (3.7 d / K)
K = 0.00065 - IN.
2-IN. 10-IN. 18-IN.
4-IN. 12-IN. 20-IN.
6-IN. 14-IN. 22-IN.
8-IN. 16-IN. 24-IN.
SOLID POINTS - OIL FLOW
OPEN POINTS - GAS FLOW
SCHED. 40 PIPE SIZES
D = 1/√f, FRICTION MULTIPLIER OR TRANSMISSION FACTOR
REYNOLDS NUMBER = 20.14 (MCFD)(S.G.) / d μ (LF)

TRANSMISSION FACTOR, D, to be used with Equation 4. Fig. 10.



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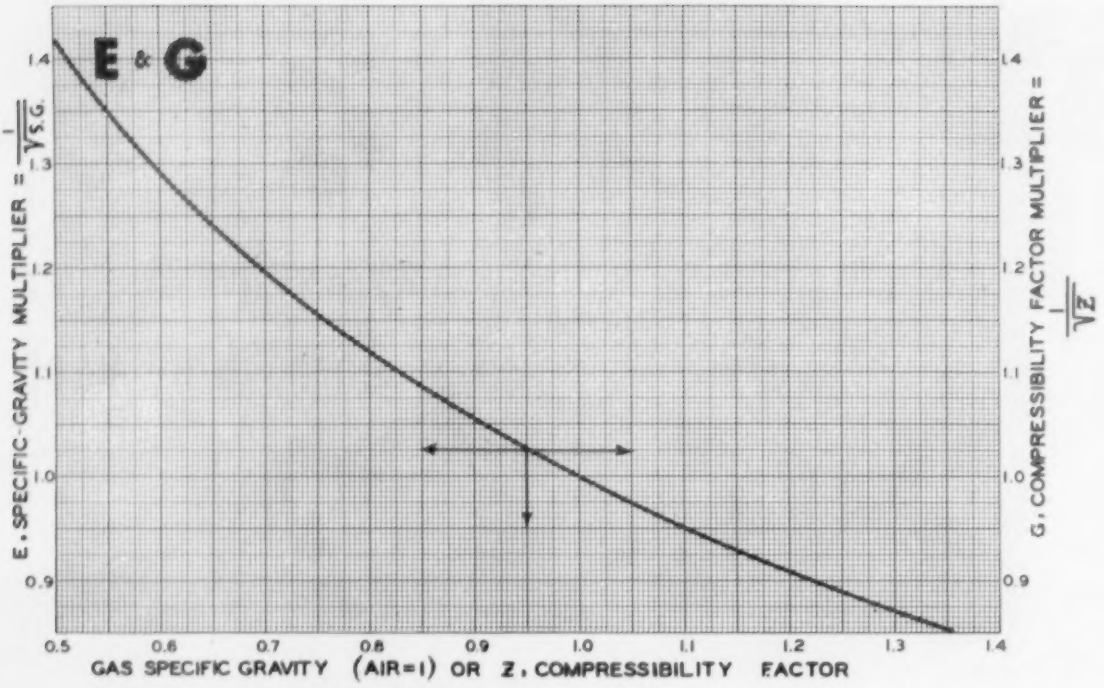


GRAVITY AND COMPRESSIBILITY multiplying factors E and G to be used with Equation 4. Fig. 11.

Natural Gas . . . Natural-Gas Pipelines

found in Table 4. Terms D, E, F, and G are given in Figs. 10 through 12.

Final check of gathering-system design . . . Equation 4 may be used for determining accurate values for pressure, flow, and diameter in the various sections of the gathering line. The following procedure is suggested:

1. Terms E, F, G, and load factor may be combined into one constant for laterals and one for main lines.

2. Equation 4 may then be expressed in the form:

$$A = \frac{(\text{a constant})\ Q}{BCD} \qquad (5)$$

3. The inside diameter of the commercial pipe from the preliminary design is used to calculate the Reynolds number. For any field the Reynolds number usually can be expressed as:

$$Re = \frac{(\text{a constant})\ Q}{d}$$

This constant again will be different for laterals and main lines. The term "D" is read from Fig. 10.

4. The term "D" is substituted into Equation 5 and "A" is evaluated.

5. If the calculations are started at the field separator end of the lines the initial pressure P_1 is known. To solve for P_2 use the equation:

$$P_2 = (P_1^2 - A^2)^{1/2} = (P_2^2)^{1/2}$$

The desk calculator is very helpful for this step. A table of squares and square roots found in most handbooks will speed up the solution.

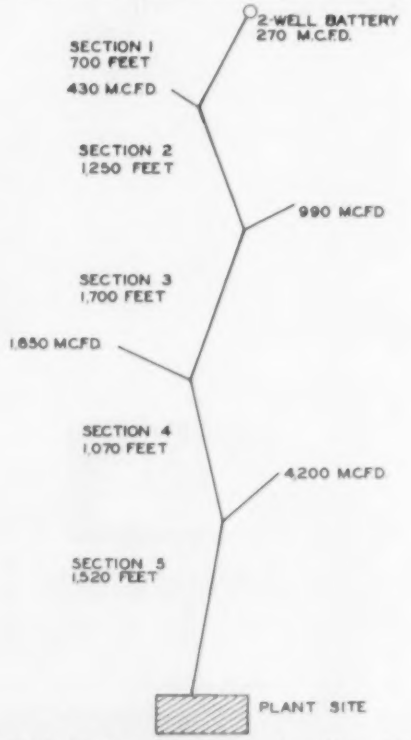
Since P_2 for the first section of the gathering line is the P_1 for the second section, the value of P_2^2 can be retained for use in the next section.

6. If the recalculated pressures are not satisfactory, the diameter of the section being considered should be altered and the calculation repeated.

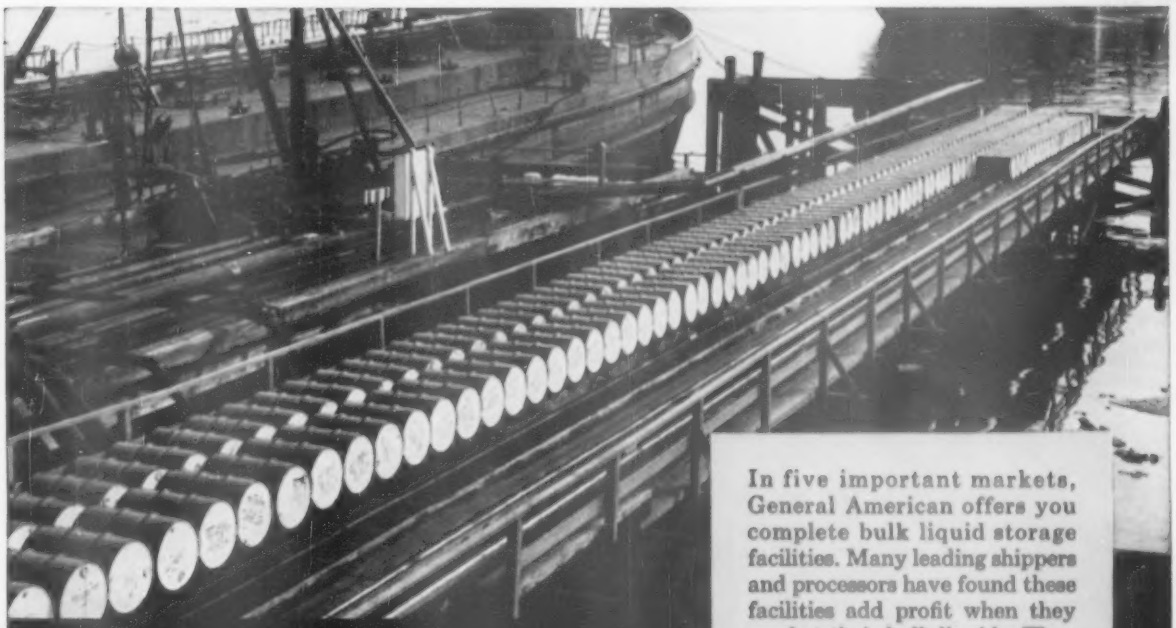
Sample Solution

The design of a part of a casing-head gas-gathering system.

Location: Texas Panhandle. Layout: See Fig. 13.



LAYOUT of gathering system for sample problem. Fig. 13.



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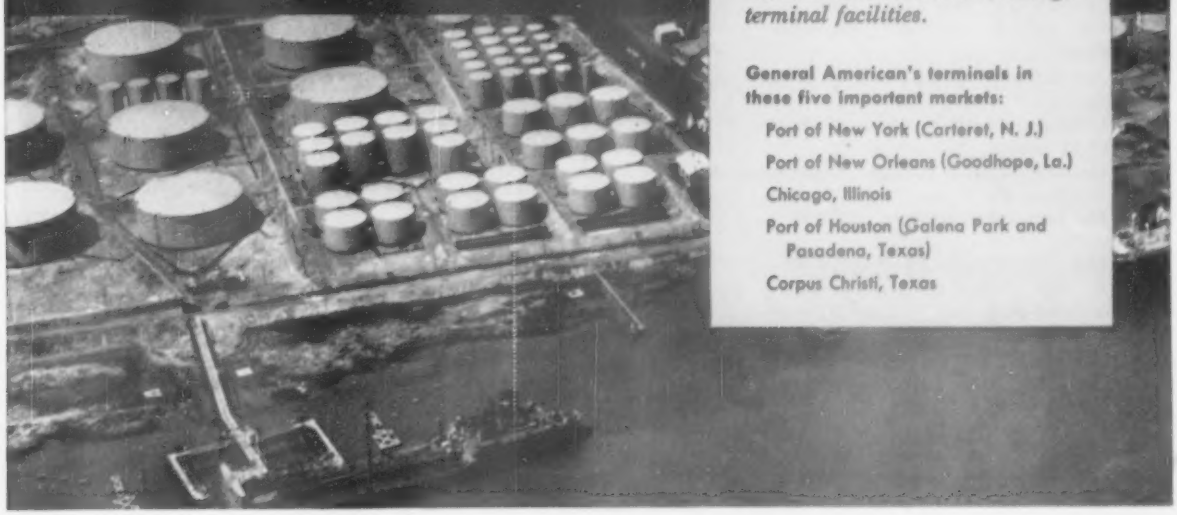
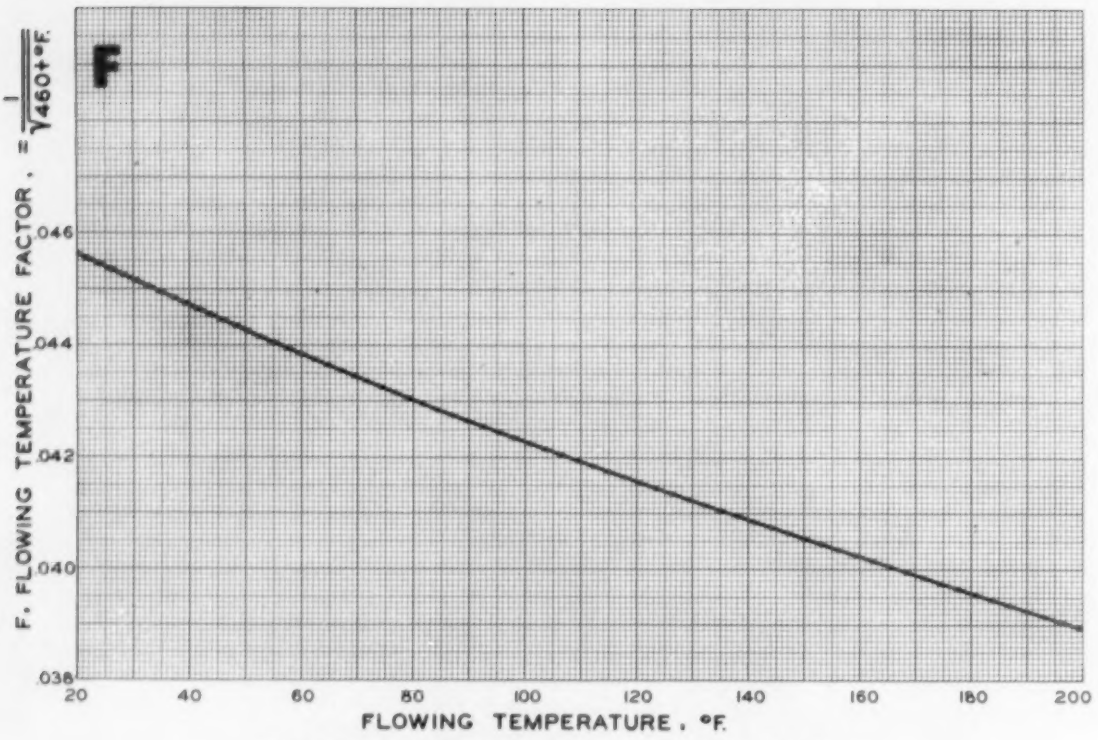
- Corpus Christi, Texas





FLOW TEMPERATURE factor to be used with Equation 4. Fig. 12.

Natural Gas . . . Natural-Gas Pipelines

1. Design by Equation 3, d = MOBILGAS

Given:

Distance from plant to most remote well = 6,240 ft. (Fig. 13).

Plant suction pressure, 13.3 psia. Atmospheric pressure, 13.1 psia.

Pressure drop across plant inlet meters and regulators, 0.25 psi.

Pressure drop across oil-field separator, regulators, and meters, 0.25 psi.

Solution:

Assume a pressure drop of 0.7 psi./1,000 ft. (Table 1).

Gathering-system pressure at plant = 13.3 + 0.25 = 13.55 psia.

Gathering-system pressure at separator = 13.55 + 0.7 (6.24) = 17.92 psia.

Field-separator pressure = 17.92 + 0.25 = 18.17 psia.

Gas gravity = 0.83 (air = 1). L = 0.963 (Fig. 5).

Average ground temperature = 57° F. (Table 2). G = 3.488 (Fig. 6).

Load factor = 0.5 for laterals. A = 1.32 (Fig. 7).

Load factor = 0.75 for main line. A = 1.125 (Fig. 7).

Compressibility factor Z = 1.0. S = 1.0 (Fig. 8).

For laterals LGAS = (0.963) (3.488) (1.32) (1.0) = 4.434.

For main lines LGAS = (0.963) (3.488) (1.125) (1.0) = 3.779.

Gas viscosity at 57° F. = 0.0096 cp.

Reynolds number

$$= \frac{(20.14)\,(0.83)}{(0.0096)\,(0.5)} \frac{(\text{M.c.f.d.})}{\text{d}} = 3{,}483 \frac{(\text{M.c.f.d.})}{\text{d}}$$

for laterals.

$$\text{Reynolds number} = 2{,}322 \frac{(\text{M.c.f.d.})}{\text{d}} \text{ for main lines.}$$

Use a pipeline efficiency of 0.9 for design.

A summary of these calculations is given in Table 5.

2. Recheck Pressures With Equation 4, Q = 100 ABCDEFG (LF)

E = 1.108 (Fig. 11); F = 0.0439 (Fig. 12); G = 1.0 (Fig. 11).

For lateral lines EFG (LF) = (1.108) (0.0439) (1) (0.5) = 0.0243.

For main lines EFG (LF) = (1.108) (0.0439) (1) (0.75) = 0.0365.

Rearranging Equation 4:

$$A = \frac{0.412\,Q}{BCD} \text{ for laterals}$$

$$A = \frac{0.274\,Q}{BCD} \text{ for main lines}$$

A summary of these calculations is shown in Table 6.

Acknowledgments

The authors wish to thank Magnolia Petroleum Co. for permission to publish this information. B. C. Barnes,

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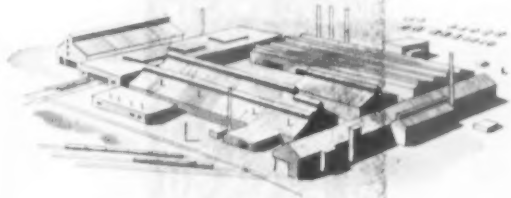

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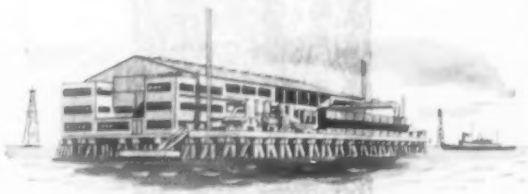

PRESSURE MAINTENANCE plant for Venezuelan gas reservoir built in 62 ft. of water with 50,000 h.p.

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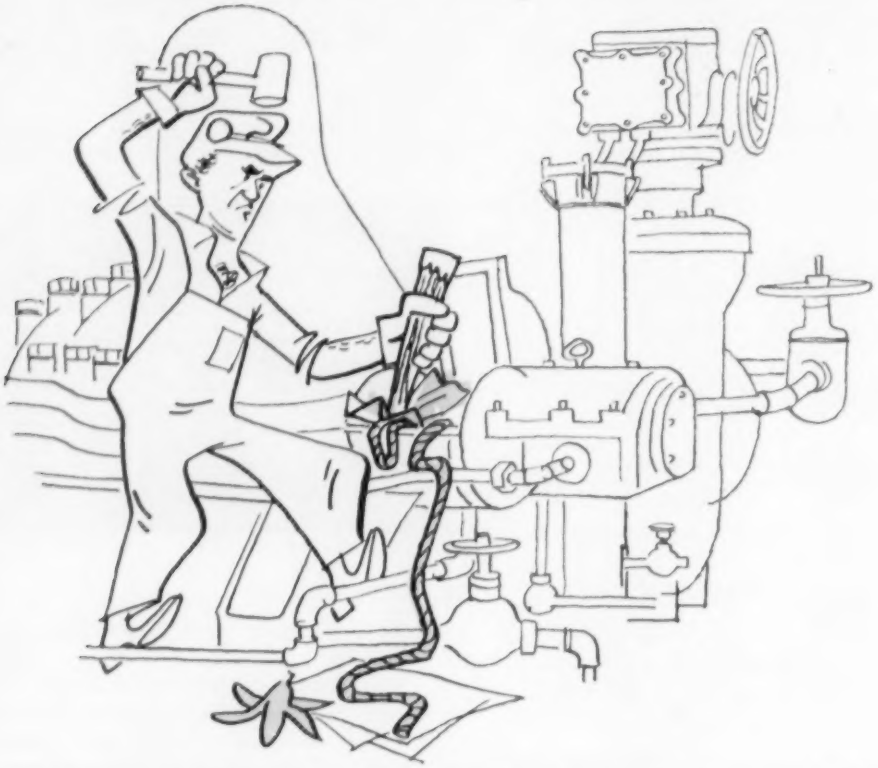

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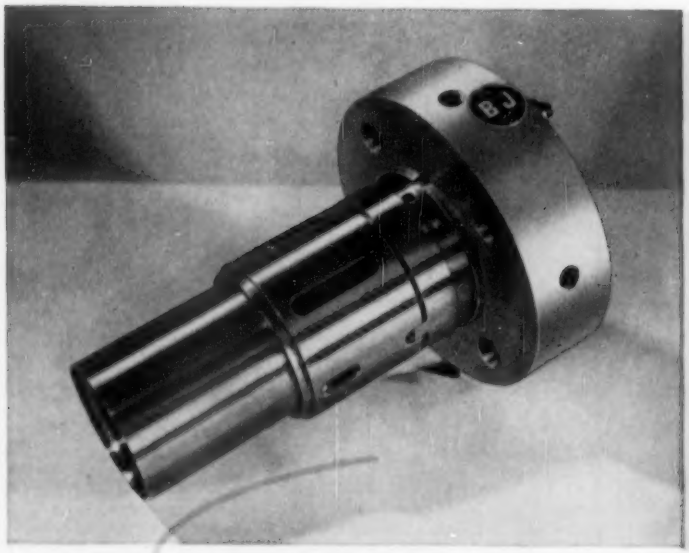

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TABLE 5—RESULTS OF SAMPLE CALCULATIONS

Line section No. (Laterals)	Flow rate, M.c.f.d.	Length of line, (ft.)	Pressure at inlet of section P_1, psia.	Pressure at outlet of section P_2, psia.	Factors of Equation 3 M	O	B	I	EGAS	d, in. from Eq. 3	d, (to purchase) inside pipe size, in.
1	270	700	17.92	17.36	8.1	0.660	0.55	0.342	4.434	4.456	4.026
2	700	1,250	17.36	16.49	11.9	0.743	0.51	0.336	4.434	6.717	6.407
(Main line)											
3	1,690	1,700	16.49	15.30	17.0	0.795	0.48	0.333	3.779	8.166	8.407
4	3,340	1,070	15.30	14.55	22.3	0.720	0.54	0.327	3.779	10.77	10.532
5	7,540	1,520	14.55	13.55	31.0	0.773	0.51	0.322	3.779	14.868	15.656

TABLE 6—RESULTS OF SAMPLE CALCULATIONS

Line section No. (Laterals)	Q M.c.f.d.	Length of line (ft.)	Preliminary d (in.)	B (Fig. 9)	C (Table 4)	D (Fig. 10)	A $(P_1^2-P_2^2)^{1/2}$	P_2^2	Psia. P_1	P_2
1	270	700	4.026	0.0378	32.5	14.58	6.211	282.551	17.92	16.81
2	700	1,250	6.407	0.0281	104	15.26	6.467	243.729	16.81	15.52
			It is apparent that the 4.026-in. i.d. pipe is too small for Section 1. 6.407-in. i.d. pipe should be used. Therefore recalculate.							
(Laterals)										
1	270	700	6.407	0.0378	104	13.95	2.028	317.013	17.92	17.81
2	700	1,250	6.407	0.0281	104	15.26	6.467	275.191	17.81	16.59
(Main lines)										
3	1,690	1,700	8.407	0.0241	205	15.59	6.080	239.191	16.59	15.47
4	3,340	1,070	10.532	0.0303	359	16.27	5.171	212.452	15.47	14.58
5	7,540	1,520	15.656	0.0254	960	16.83	5.034	187.111	14.58	13.68
			These sizes are satisfactory. The plant inlet pressure is within 0.13 psi. of that specified in the design condition.							

Natural Gas . . . Natural-Gas Pipelines

chief of the process engineering section of the natural-gas department, and D. P. Penick, process engineer, supplied data and reviewed the presentation. R. H. Parekh, process engineer; J. W. Parish and A. R. Bourland, district engineers, supplied test data on field-gathering systems.

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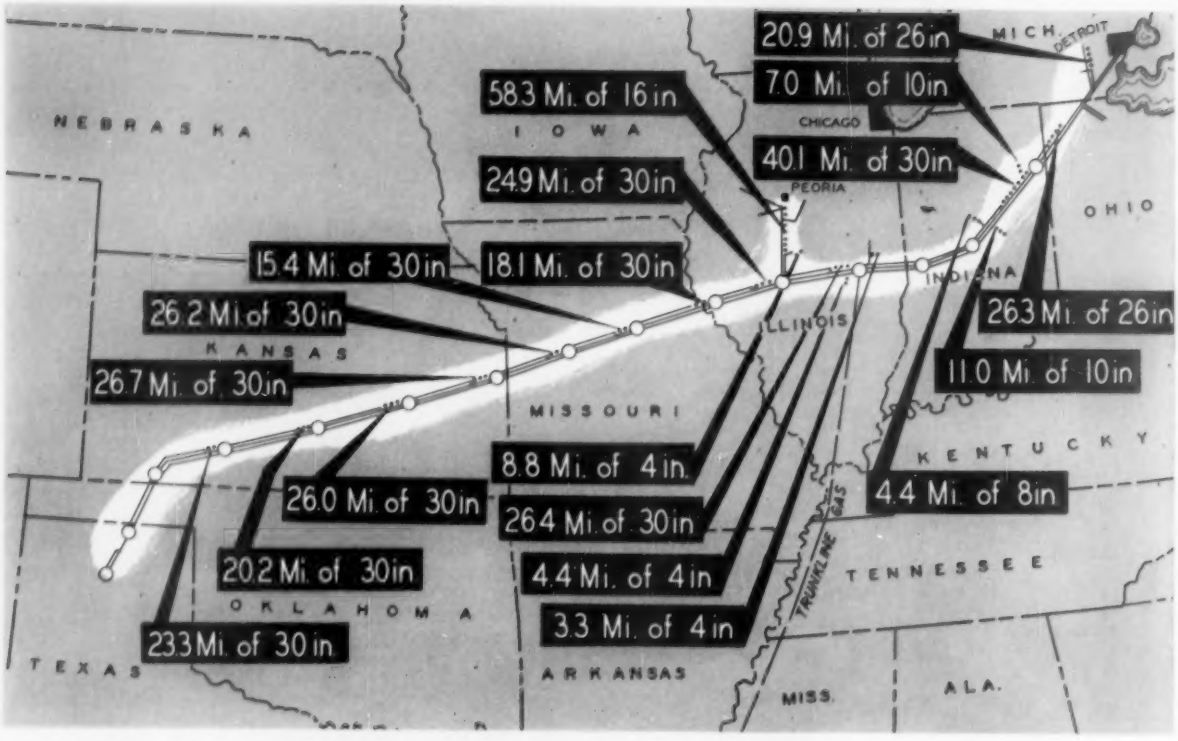


Panhandle Eastern closes the gaps in its third main pipeline across the Midwest

295-Mile Looping Program Completed

. . . raising system's peak delivery to 1,070,000 M.c.f. daily

by S. A. Bergman

THE Panhandle Eastern Pipe Line Co. completed its third main pipeline across Kansas, Missouri, Illinois, Indiana, and Ohio and laid loop extensions in Michigan during the last quarter of 1954. The main-line additions were the first step in an expansion program which will increase the company's maximum sales capacity to 1,425,000 M.c.f. per day.

Designed to enlarge the system's peak delivery from 970,000 M.c.f. per day to 1,070,000 M.c.f. per day, authority to proceed with the first phase of the program was granted by the Federal Power Commission on September 2, 1954. Sixteen days later a contractor's crew started clearing right-of-way on the 295-mile project and by the middle of December, the new lines were ready for service. More than 2,000 workmen were employed and some 600 pieces of construction equipment were in use at the peak of activity.

The author is chief engineer, Panhandle Eastern Pipe Line Co., Kansas City, Mo.

The engineering department had been anticipating a certificate of convenience and necessity. Early in July it had mailed to contractors requests for bids on 12 proposed loop extensions totaling 248 miles of 30-in. pipe and 47 miles of 26-in. pipe. Consequently, upon receipt of the FPC's authority to proceed, successful bidders were notified within hours. Contracts were awarded to five pipeline contractors who were required to provide a total of eight spreads. A sixth contractor was committed to the construction of a dual Mississippi River crossing.

Tentative orders for pipe were made firm September 3, requiring that deliveries begin within 30 days. Supplied by three steel companies, the pipe was shipped from four rolling mills in California, Alabama, Ohio, and Pennsylvania. Pipe for the loops was 30-in. o.d. by $\frac{7}{16}$-in. wall, except for the loops in Ohio and Michigan which were 26-in. o.d. by $\frac{3}{8}$-in. Pipe for compressor station yards and highway and railroad crossings was ½-in. wall, while the Mississippi River crossing pipe was 24-in. o.d. by $1\frac{3}{16}$-in. All pipe was 40-ft. length except that from the Republic mill in Alabama, which was 30-ft. random length. The Republic pipe, however, was double jointed and X-rayed at the mill and shipped in 60-ft. random lengths. The weight of all pipe required in the project was just under 78,000 tons.

Pipe deliveries began the week of October 4, and continued at a steady rate of about 10 miles of pipe a week from each mill. Lost time due to poor deliveries was negligible, and deliveries of pipe and other materials were considered good to excellent.

TWO LINES across the Mississippi were laid at this site. The 24-in. pipe used had a wall thickness of 1 $\frac{1}{16}$-in., heavy enough to be laid without extra weights.

Natural Gas . . . Natural-Gas Pipelines

New laying equipment . . . Performance of the contractors was a major factor in the rapid execution of the work. Moving in quickly, each spread had cleared the right-of-way, and was ready to string when the first carloads of pipe began to arrive. Their equipment was the best ever used on Panhandle's pipeline construction.

An oversize sideboom tractor, designed to handle 36-in. pipe, was given its first field test on the Liberal, Kans. loop. Weighing about 78,000 lb., the pipe layer is powered by a 190-hp. diesel engine and has a lifting capacity of 130,000 lb. Another innovation on Panhandle's construction was a four-generator welding unit mounted on an Athey wagon. These four generators served the stringer-bead welders in the pipe gang of one of the contractors. Three stringer-bead welders worked simultaneously. The fourth welding unit on the Athey wagon was a spare.

Especially instrumental in keeping spreads on schedule were the new quadruple rock drills which speeded the removal of 66,000 cu. yd. of hard limestone prevalent in the flint hills of eastern Kansas. Keeping pace with drilling and blasting on one Kansas loop were 13 backhoes, 11 on another.

The usual frequency of farm drainage-tile crossings between western Illinois and Michigan was encountered. More than 2,700 tile-crossing replacements were made, and late autumn rains more than offset the earlier advantage of low water tables.

Minor river pipeline crossings were constructed as an integral part of the loop construction project including the Osage River in Kansas, the Salamonie, St. Mary, and Wabash rivers in Indiana, and the Maumee and Tiffin rivers in Ohio, all utilizing ½-in. wall 30-in. pipe, river clamps, and rod anchors.

Loop lines were coated with coal tar primer and enamel, 3/32-in. thick. A reinforcing wrap of 8-lb. perforated asbestos felt was applied over the hot enamel. And in rocky areas, where there was no dirt backfill for padding, rock shield was used to protect the coating. Test leads were provided for checking the cathodic protection.

Radiographic inspection was used on about 15 per cent of the welds except in river crossings where this inspection was used on all welds. An average of about one weld in 3 miles proved to be unsatisfactory or was questionable and cut out.

Smoothly Drawn Nozzles Used in Lieu of Saddle-Reinforced Outlets

An innovation in Panhandle's construction last year was the use of smoothly drawn nozzles in lieu of saddle-reinforced outlets on the loops and river headers. All gate-valve settings and lateral connections were fabricated using the new nozzle outlets. No flanges, bolt studs, or reinforced saddles were used on the new construction.

The idea of using nozzles was conceived by the engineering department following a study of failures of saddle connections. They concluded that most of these failures would not have occurred had smoothly drawn outlets been used. But a decision to switch to nozzles posed a problem in procurement, since the forging manufacturers had very little experience in commercially producing drawn outlets, other than forged tees.

Arrangements were made with a manufacturer of forged-steel fittings to supply the dozen or more sizes and combinations of outlets required. Production of the drawn outlets presented new problems, made more difficult by the requirement that multiple outlets be drawn from a single-section carrier pipe.

Reducing Tees

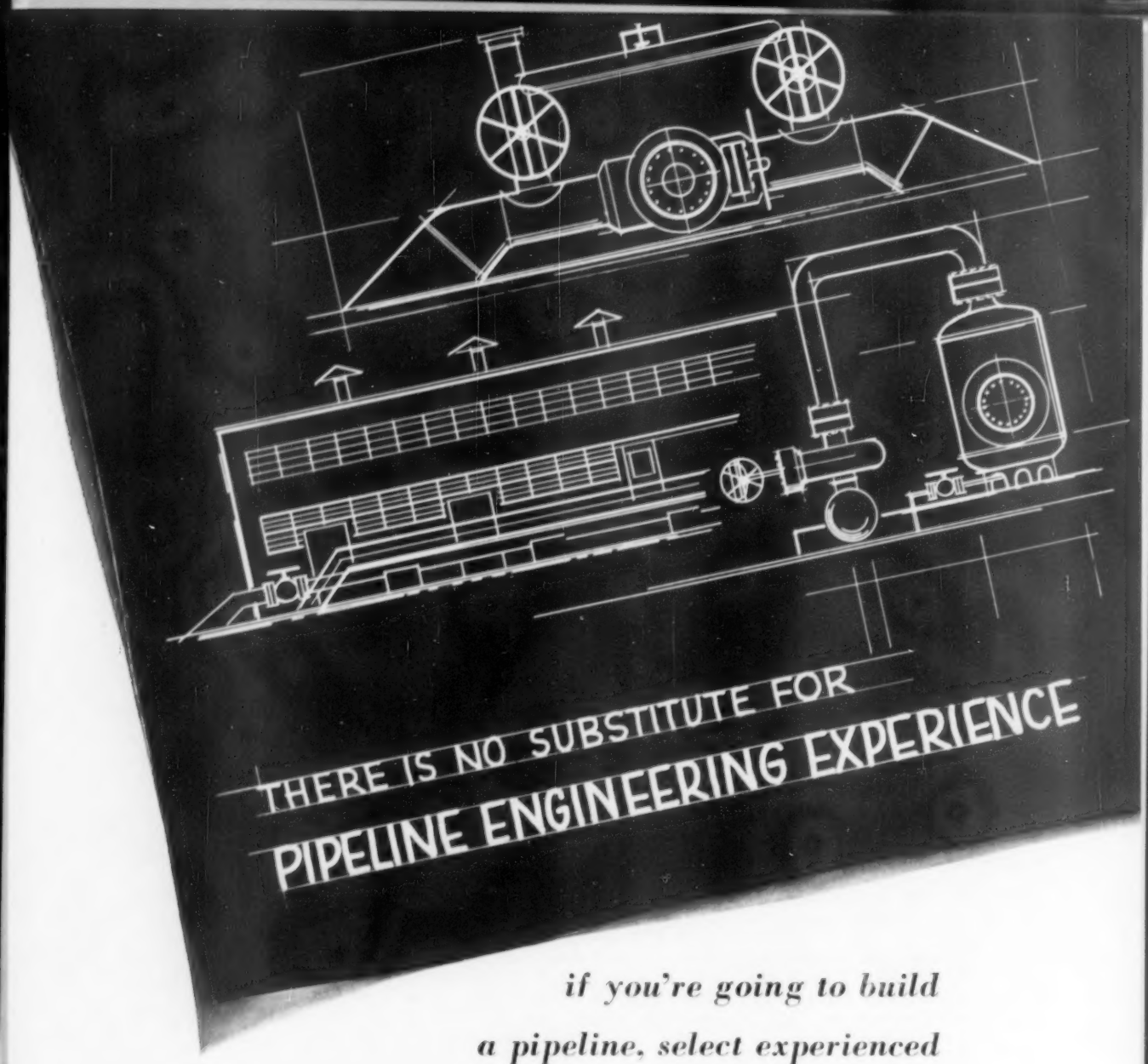
An example was the pair of triple-outlet reducing tees designed for main-line gate settings. Drawn from 30-in. o.d. pipe were 6, 8, and 12-in. outlets, each in a different quadrant of the pipe. A 30 by 20-in. reducer was drawn separately and factory welded to the 30-in. multiple-nozzle component. Both parts of the reducer tee were made from selected stock having ⅜-in. wall and a minimum yield of 42,000 psi. These specifications were necessary to provide sufficient crotch and outer wall thicknesses of the outlets and to give the degree of ductility required for the drawing operations. Other drawn fittings included double outlet, single outlet, and reducing tees, in 30 and 26-in. stock.

The outlets were counterbored to the wall thickness of the fitting to which they were to be welded. Each product was quarter marked and its field location was stenciled at the factory as an aid to field fabrication. All factory welds were X-rayed and stress relieved.

The field fabrication of a gate setting using drawn outlets required about 30 per cent of the time consumed in the construction of a setting using saddles. The over-all cost, including the cost of materials, was found to be somewhat less than that previously experienced.

The excellent cooperation of the various vendors, landowners, and weather, and the all-out effort by the contractors aided in completing the work on schedule.

The use of lowering-in cradles developed by Panhandle Eastern also speeded the work and further proved their value as a coming standard item of pipeline equipment.



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Natural Gas . . .
Natural-Gas Pipelines

Twin Lines Across Mississippi River

An interesting operation of the 1954 construction was the installation of the twin 4,200-ft. lines across the Mississippi River. For the first time in the company's operation, pipe with wall thickness greater than ½-in. was used for river crossings. This project used 1⅛-in. wall river pipe. The location of this crossing is about 1 mile upstream of the Champ Clark Bridge at Louisiana, Mo., and was selected last June.

Jet soundings showed no solid rock would be encountered at the desired underwater-trench elevations. The survey indicated a rock formation below the proposed trenches with gravel overburden extending to an elevation above the top of the two lines. Overlying the gravel was sand and silt.

In addition to the ideal subsurface condition, the location is particularly advantageous from the standpoint of water velocity. This location is in the upper reaches of a pool created by a dam about 12 miles downstream. This cuts water velocity to a minimum and reduces exposure to erosion. As a comparison of cost, the submerged crossing cost approximately 25 per cent of what a bridge would have cost at this location.

The submerged crossing of the 24-in. lines was completed on December 14, just 90 days after a construction agreement was signed with the contractor.

Straight crossings . . . This major underwater stream crossing was laid without camber straight across the river in trenches averaging 20 ft. deep. The lines between river banks were 24-in. o.d. by 1⅛-in. wall laid on 50-ft. centers, closing to 10-ft. centers over the levee on east bank.

An integral part of the 30-in. o.d. loop design, two 24-in. o.d. lines were selected for the crossing. Their combined gas flow capacity would practically equal that of a comparable length of the single 30-in. loop line on either side of the river.

Laid deep in stable material, the 1⅛-in. wall pipe required no paint and no weights. It was pulled into position at a cost considerably less than would have been expended had the crossing been laid from a ramp barge. The two lines laid as tangents required some 400 ft. of pipe less than curved lines, thus saving materials, and the cost of additional dredging, welding, laying, and backfilling.

The 24 by 1⅛-in. river pipe was Grade A seamless having a minimum yield strength of 30,000 psi. This pipe will withstand the stresses to which it will be subjected after installation as well as being strong enough to undergo handling during the construction.

Manifold on east bank of Mississippi where the dual 24-in. crossing tied in to the 30-in. Drawn nozzles at all valve installations like this eliminated saddle-reinforced outlets.

Headers and gates were located west of the railroad on the right bank and were protected by the levee on the left bank, the locations being as close to access roads as practicable.

The pipe was fabricated in a storage area east of the levee. Sections averaged about 317 ft. At the same time two 12 by 14-in. dredges, working from the banks, prepared some 500 to 600 ft. of trench for each line.

Welding procedures conformed to the A.P.I. tentative standard for welding of pipelines. Downhill welding was used. The welding rod used for heavy-wall pipe was American Welding Society Class 6010, size 5/32-in. for stringer beads and hot passes, and ⅛-in. for filler beads and caps. Forty pounds or more of rod was required to complete each weld. All welds were X-rayed.

A winch rated at 80-ton drawbar pull with 4,000 ft. of 1-in. cable, and anchored to deadmen on the west bank, pulled the downstream line across the river in 6 days. Anchored barges and two dredges upstream held the pipe from being forced downstream by the river's current. Other barges and pontoons supported the pipe. Four sideboom D-8 tractors eased the line to water's edge, as welders extended the line section by section.

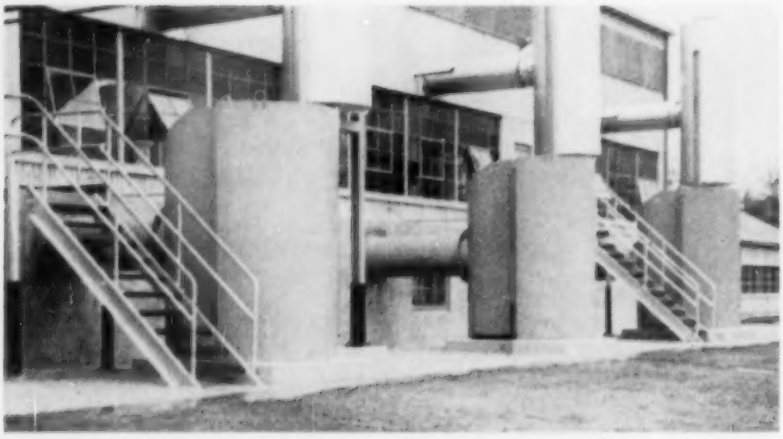
The upstream line was installed in a similar manner. Each line was then dredged to final grade, the spoil being deposited over the pipe in the trench well astern of the dredges. Soundings taken as the pipe was lowered showed the line on grade about 80 ft. astern of the dredges, or 150 ft. from where it lay on the undisturbed river bed. One pass of the dredges lowered the pipe to grade. But since critical stresses would be imposed on the pipe where the dredges would meet, the last 200 ft. of each line was lowered in two or more passes. This allowed the pipe to lower gradually over a distance of about 500 ft. A minimum of 6 ft. of backfill was deposited over the lines after they were hydrostatically tested to 1,000 psi.

"Gate valve settings using drawn outlets required only 30 per cent of the time consumed in setting gates by using saddle reinforcements."

QUIET! Men at Work

Here's how nerve-shattering noise was reduced at one company's compressor stations. Result: more efficiency, better morale, and no more ringing in ears after hours.

by C. S. Kenworthy



EXHAUST AND INTAKE side of engine-room building, showing the exhaust silencer as well as the intake filter with the elliptical baffles for reflecting sound back into engine piping. Fig. 1.

WHEN, because of intense noise, it becomes practically impossible to carry on any kind of a conversation in an engine room—

When men go home from work with the sound of the engines ringing in their ears for hours after they have left the engine room—

When, even after the ringing in their ears finally disappears, the men who live in company cottages are continually aware of a drumming sensation caused by the low frequency sound waves from the engine air intake piping—

Then noise has become a major problem in the operation of a compressor station.

That was the situation when the first five compressor stations were first put into operation on the Texas Illinois Natural Gas Pipeline system. A decibel meter indicated a noise intensity of 113 db. in the engine room and of 125 db. outside the main engine room in the proximity of the engine air-intake filters and exhaust mufflers.

First work . . . The first step that was taken to improve the conditions in the cottage area and in the office was an experiment conducted with an elliptical baffle in front of the air filter screen. An air filter without the baffle is shown in Fig. 6. The experimental work proved that a simple baffle the same height as the filter screen allowed the low-frequency waves to penetrate the cottage area and the office at practically full intensity.

When this baffle was made to extend from the ground level to 2 ft. above the top of the filter the serious pulsations at the office and cottages was reduced to a satisfactory level. The drumming sensation was eliminated. In addition the very loud and undesirable noise directly in front of the filters was greatly reduced. The final arrangement of baffle used is shown in Fig. 1. This type of baffle extends only to the top of the filter but contains a top or cover extending over to the filter body. The air enters the filter from the engine room side between the sides of the baffle and the sides of the filter.

Up to this point in the noise investigation, a db. meter was not readily available and had been used only in a preliminary way before doing the above work. A sound-level meter, an octave-band analyzer, and a vibration pickup were obtained and used in connection with all additional work. The sound-level meter measures the over-all sound-pressure level. The octave-band analyzer indicates the sound-pressure level for eight ranges of frequency from 20 to 10,000 cycles per second. The curves on Fig. 2 indicate the sound pressure level at the various frequency bands. The over-all level is shown for each curve in the description at the top of the curve sheet. The vibration pickup measures the velocity and displacement of a vibrating surface. The vibration readings taken of an exhaust manifold led to the insulating of these manifolds.

These instruments are invaluable in any investigation of noise. Although the human ear is a very accurate noise meter, it unfortunately furnishes no means of recording the results. We have found, however, that observations of sound as heard by the human ear are invaluable in helping to determine the sources of noise as well as a double check on the results obtained. This is especially important because of the fact that the readings taken on a db. meter are greatly affected by atmospheric conditions, and comparisons are therefore difficult to coordinate.

The decibel . . . Sound level is measured in decibels. All sound is referred to sound pressure of 0.0002 microbar, or 0 db. This point is the weakest sound that can be heard by a person with a very good hearing in an extremely quiet location. The db. scale is logarithmic. At any sound level an increase of 3 db. doubles the sound level. A sound level of 20 is still only a loud whisper. Conversational speech has a sound level of about 60 or 70 db. A 10-hp. outboard motor close to the the point of measurement would indicate a noise level in the neighborhood of 90 db.

A reading taken close to a trumpet auto horn might be in the range of 110 to 120 db. It is apparent that when working at high sound levels an increase of 3 db. (a doubling of the sound level) requires a very decided change in noise energy. In attempting to bring about a reduction in engine-room noise level from 113 db. down to a value approaching 100, the problem must necessarily be attacked from several different angles.

Reduce reverberation . . . After the installation of the baffles in front of the air filters, the second and third

Author is general superintendent of compressor stations, United Gas Pipeline Co. of America, Chicago.

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ACCIDENT FREQUENCY RATE:*
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** Based on reports of pipe line construction firms participating in the Pipeline Contractor's Association safety program: Six months period ending December 31, 1954.

*** Based on twelve month period ending March 31, 1955.

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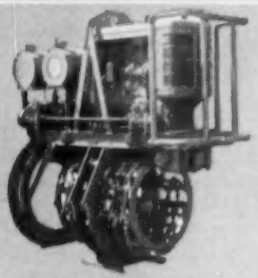
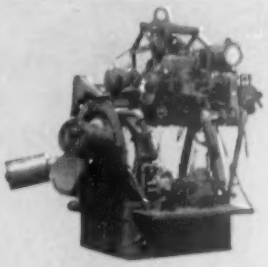
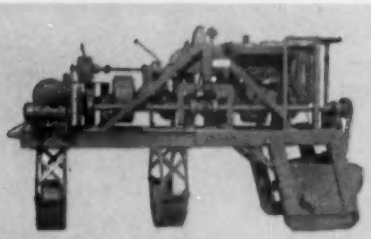


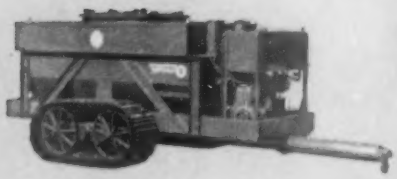
Cleaning and Priming Machines



Coating and Wrapping Machines



Road Boring Machines



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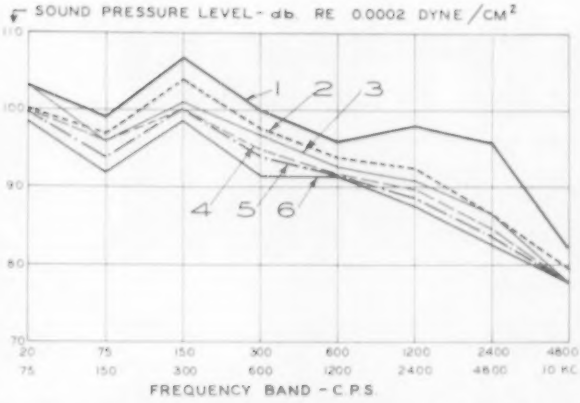
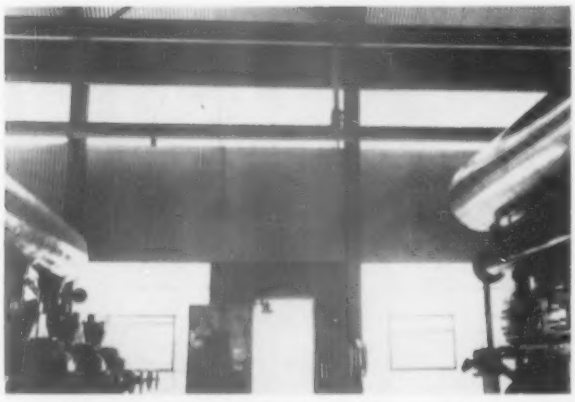


COMPARISON of octave band readings at various stages of the work. All readings taken with meters located between engines 2 and 3, and with all six engines running at 320 r.p.m. and about 2,000 hp. load per engine. The curves: (1) original readings (over-all 113 db.); (2) exhaust manifolds covered (over-all 110 db.); (3) exhaust manifolds covered and acoustical treatment on walls and roof (over-all 107 db.); (4) cones installed in all exhaust stacks (over-all 107 db.); (5) operating two scavenge pumps instead of three (over-all 106 db.); (6) cones installed on all intake pipes (over-all 105 db.). Fig. 2.



SECTION OF ENGINE ROOM showing the completed insulation job on the engine exhaust manifold and on the interior of the building. Fig. 3.

steps in noise reduction were attempts to reduce the noise reverberation rather than the primary source of noise. The effects of insulating the exhaust manifold and the inside walls and roof of the main building have been covered in the literature. The results of this work are shown in the first three curves of Fig. 2.

The over-all sound-level reduction was approximately 6 db., the larger portion of the reduction being accomplished by the exhaust manifold insulation. The exhaust was covered with a 3-in. layer of preformed glass-fiber pipe insulation with a jacket of 20-gage sheet aluminum. At the ends of the manifold at the uncooled portions asbestos cement was used instead of the fiber glass.

On the walls and ceiling a 3-in.-thick glass-fiber blanket furnished in pieces 4 ft. wide by 25 ft. long was installed between the roof purlins and the wall girts. This material was covered with perforated, corrugated material made of 24-gage aluminum sheets. Fig. 3 shows a section of an insulated exhaust manifold at the right of the picture and a section of the insulated walls and roof in the background.

Insulation location . . . The distribution of insulation in an engine room does not seem to be important. Mesh bags containing insulating material were hung well distributed throughout the building and concentrated at intermediate points and finally piled in a heap on the engine-room floor, and the reduction in noise level was practically the same regardless of the distribution of the sound-absorbing medium.

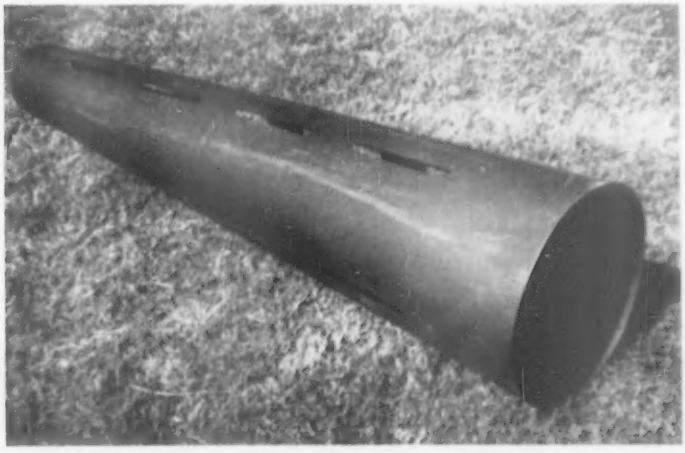
The noise of the intakes and exhausts outside of the engine room adds to the other noises in the engine room. This became very apparent when db. readings were taken in the auxiliary building with the main engines operating and again when the station was shut down. A drop in sound level of five db. occurred.

Natural Gas . . . Natural-Gas Pipelines

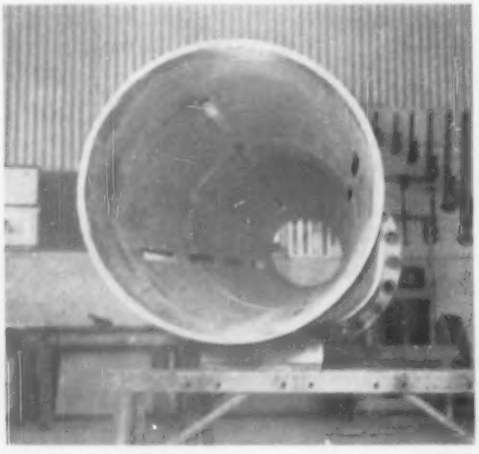
Truncated cones . . . Many discussions of the sound problem pointed to the possibility of using truncated cones in the exhaust and intake piping to break up the sound waves. There are possibly three ways in which these cones can reduce the noise as follows:

1. By using a cone one-half the wave length of the sound wave represented by the frequency of the exhaust pulses or the intake pulses, the major pulse which occurs is partially tuned out.

2. By using slots as in the case of the exhaust cone the major pulses and possibly some minor pulses may be broken up by releasing different por-



DETAIL of exhaust cone used in the stack. Fig. 4.

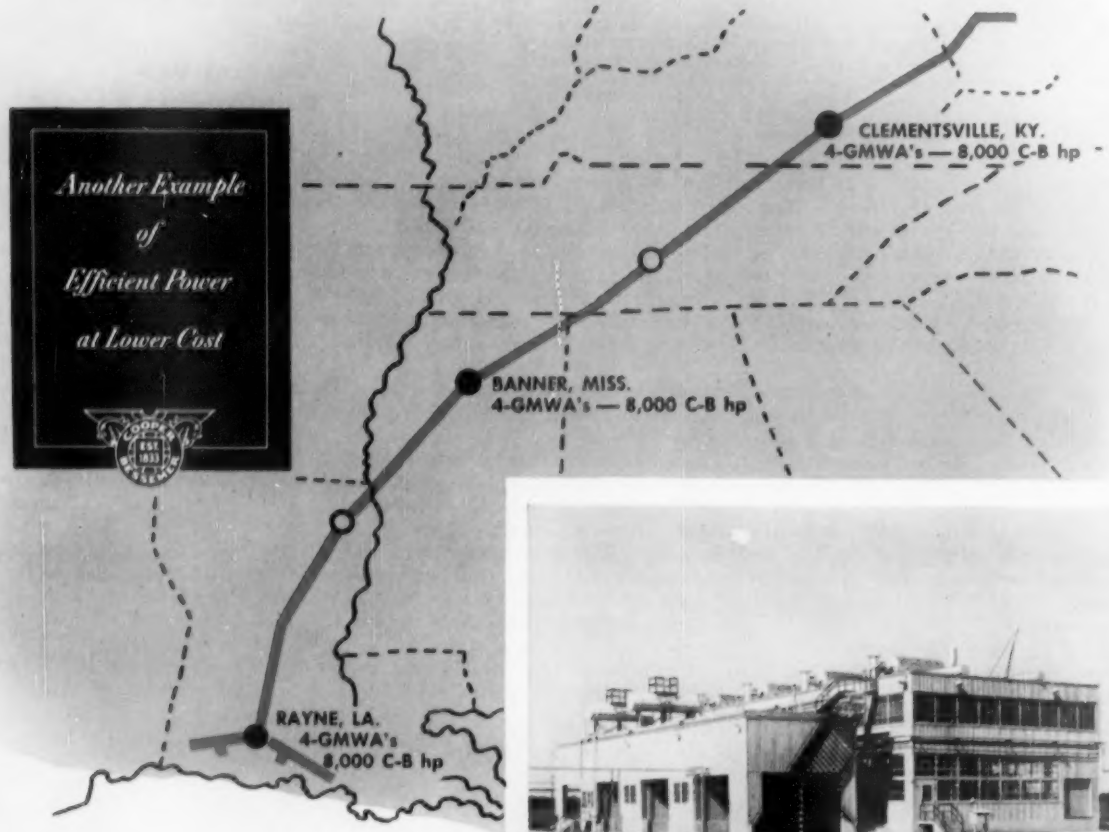


TRUNCATED CONE installed in section of exhaust pipe. Fig. 5.

PUSH-BUTTON OPERATION

on Gulf Interstate's Mainline... with Cooper-Bessemer GMWA's at 3 Key Stations

Another Example of Efficient Power at Lower Cost



● Main compressor building of the 8,000 hp Cooper-Bessemer powered Rayne station.

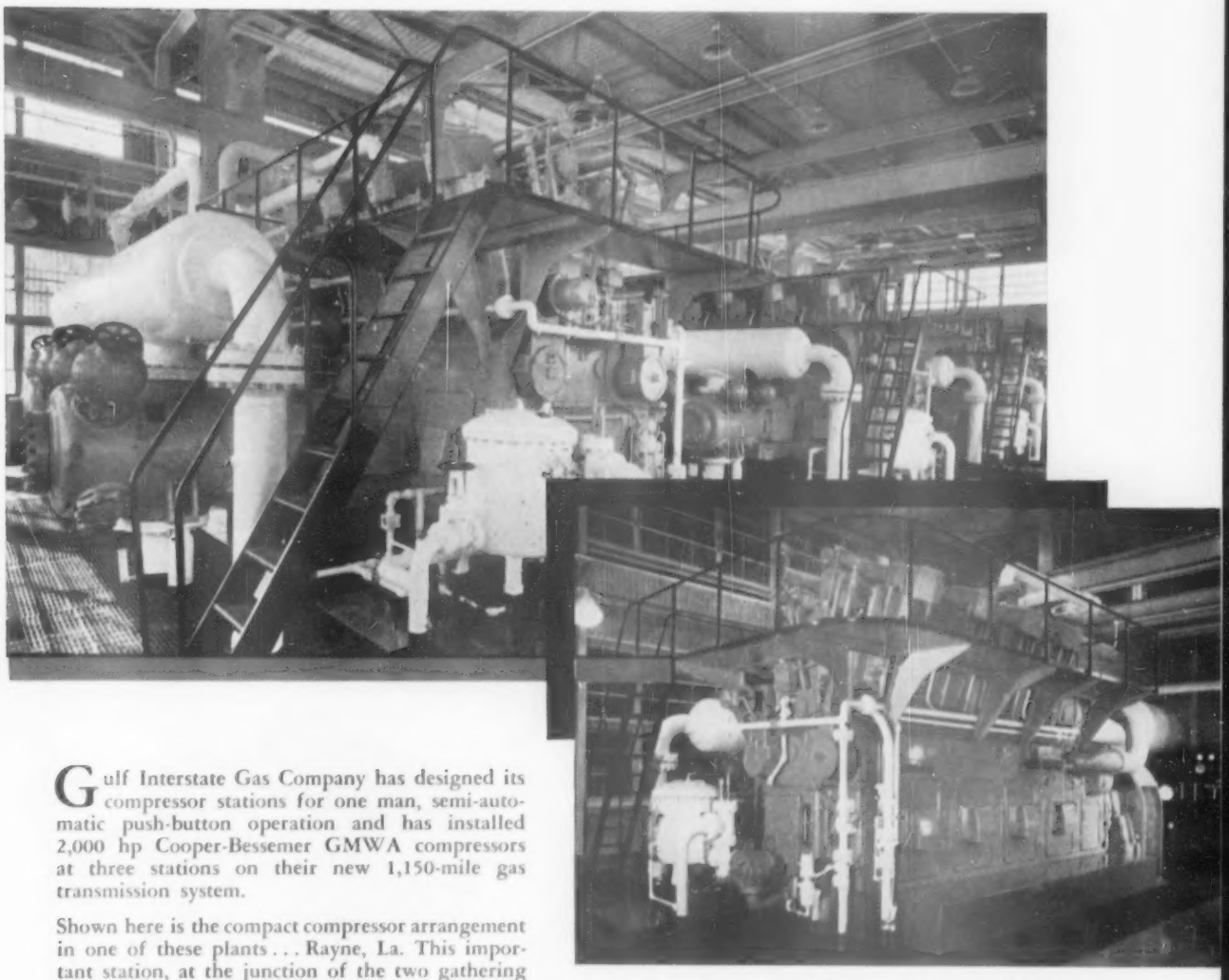
ANGLE

Compressors

New York Washington, D. C. Bradford, Pa.

San Francisco, Cal. Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle, Wash.

● Shown here from the compressor cylinder side are four of the GMWA compressors used in Gulf Interstate's transmission of natural gas from fields in southern Louisiana to West Virginia.



Gulf Interstate Gas Company has designed its compressor stations for one man, semi-automatic push-button operation and has installed 2,000 hp Cooper-Bessemer GMWA compressors at three stations on their new 1,150-mile gas transmission system.

Shown here is the compact compressor arrangement in one of these plants . . . Rayne, La. This important station, at the junction of the two gathering laterals and mainline starting point, is equipped with four 8-cylinder GMWA units, identical to those in the Banner and Clementsville stations. Each of these Cooper-Bessemer installations offers top automatic operating efficiency without sacrificing flexibility.

Helping push natural gas to the northeast, these dependable Cooper-Bessemer units can be relied upon to deliver continuous top availability, low operating expense, unmatched compressor flexibility and minimum maintenance demands.

Line-up of four Cooper-Bessemer 2000 hp GMWA V-angle units in Gulf Interstate's Rayne, La. station.

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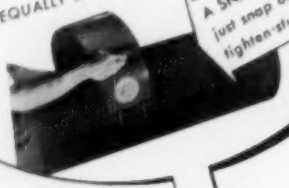

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SIZES: *any combination of pipe and casing sizes.*

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NO SHIELD RE[illegible]

to protect tough sleeve from rocky backfill

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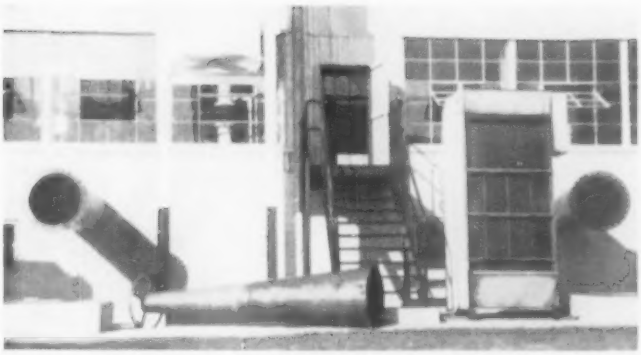
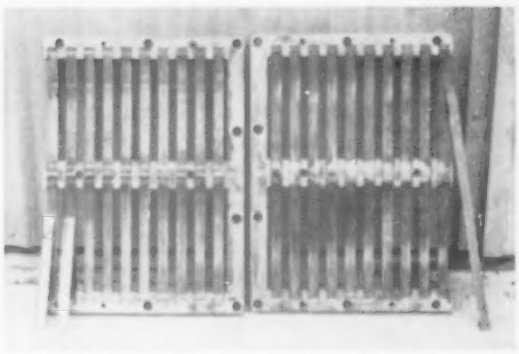


CONE used in inlet piping showing type of filter with filter removed from intake piping and without the elliptical baffle. Fig. 6.



VALVE GUARD on left is original guard with short strips. Guard on right is the remachined guard which makes use of the long strips for silencing the scavenge pump discharge. Fig. 7.

tions of the sound wave to the atmospheric pressure simultaneously.

3. The cone without much question tends to reflect sound waves back into the piping system regardless of their frequency.

One of the things which makes noise elimination in and around an engine room very difficult is the fact that sounds of so many frequencies are created. This fact makes it reasonable to use reflection as a means of reducing noise simply because a reflector of any sort can act upon sound waves of all frequencies. In spite of this, by reducing the major pulsations which occur in an exhaust or intake system, the highly undesirable comparatively low-frequency pulses which can be felt as well as heard can be reduced to a minimum. Luckily in so doing, the higher-frequency sounds are lowered at the same time.

Operation with different cone arrangements on the exhaust stack determined the size and number of slots to use. Results with the cone turned down into the stack were just as satisfactory as with it turned upward and the downward arrangement was used because of the better appearance. Fig. 4 shows the cone used in the exhaust stack and Fig. 5 shows it installed in the top end of the stack. Curve 4 in Fig. 2 shows effect on sound level.

Eliminate pump . . . The next step in reducing the noise level was to eliminate the use of one scavenge pump. This was made possible only because the excess air ratio on the engines was too large. Fortunately the spacing of the scavenge pistons on the crankshaft resulted in even smoother flow than with three pistons operating. The net result was a reduction in noise level inside and outside the engine room. The results are shown by Curve 5 in Fig. 2.

This curve indicates an appreciable improvement in the main engine room, particularly at the frequencies below 150 cycles per second. The reduction in scavenge air horsepower resulted in an improvement of approximately 0.5 cu. ft. of fuel gas per horsepower hour. This change has been made on all similar engines on the system, and there is no evidence of engine distress up to 15 per cent overload, proving the additional scavenge pump was unnecessary.

Experiments were next conducted using a cone in the intake piping. This cone was mounted with the large end welded to the piping at the connection to the intake filter, the small end pointing toward the engine and supported by the spacer shown in the picture. The best results as far as sound reduction is concerned, were obtained with a 10-ft. 6-in.-long cone, 10 in. in diameter at the small end without any slots. However, with this cone the pressure drop was excessive.

When eight slots ⅛-in. wide were used in a similar manner to the ones used in the exhaust cone, the pressure drop was reduced and the noise level raised slightly. A cone of the same size in general but with a ¼-in.-wide annular space between the pipe and the large end of the cone resulted in an appreciable reduction in pressure loss without an increase in noise level. This arrangement was therefore used.

The results of operation with the cones in the intake piping of all engines is illustrated by Curve 6 in Fig. 2.

Gear noise . . . Experiments were conducted to reduce the gear noise on the engines as well as the noise created by the scavenge pump discharge valves. Although it was determined that the ringing characteristic of the two large idler gears could be eliminated by the use of a piston ring imbedded on the inside of the gear rim, no improvement could be discerned in engine noise.

Experiments with the discharge feather valves on the scavenge pumps were on the other hand very successful. At the left in the picture, Fig. 7, is shown the original scavenge valve guard, which makes use of a series of comparatively short feather strips. These very evidently were slapping against the guard and seat of the valves and creating a very loud noise, easily discernible by anyone standing alongside of an operating engine. This noise was largely due to operation of the discharge valves.

A bakelite plate used over the valve seat reduced the noise somewhat. To further reduce it the discharge valve guards were slotted at the center to accommodate a long strip which would operate with a reserve curvature and which could not slap against the guard. The use of these long strips resulted in eliminating practically all of the valve noise. In fact, the use of the long strips without the bakelite seat reduced the valve noise sufficiently that it was decided not to use the bakelite.

All of the engines at one station were equipped with the long strips and have been operating for several months with only normal breakage. Although there is very little improvement in the noise as measured on a meter, there is sufficient difference as determined by listening to the engine operation that it is planned to adopt this arrangement at all stations.

To sum up the results of all of the above work the over-all noise level in the engine rooms has been reduced from 113 to 105. The low frequency pulsations which caused so much discomfort in the office and in the cottage area have been almost completely eliminated, and in addition the high frequency noise in the engine room which interferes with speech has been reduced to a level where men can converse with each other at a distance of 8 to 10 ft.

Reference

1. "Here's How to Control Noises in the Engine Rooms," by Seymour Lasco, Texas-Illinois Gas Pipe Line Co., Chicago. Pipe Line Industry, Vol. 1, No. 6, December 1954.

TYPICAL RIG used and terrain found in most areas of the San Juan basin.

Drilling Problems Are Rugged In the San Juan Basin

But El Paso Natural has found means of coping with the many difficulties of producing its oil

by W. W. Mize

STATISTICS grow old in a hurry in the San Juan basin. This rugged, colorful piece of real estate—a major portion of which lies in the northwest corner of New Mexico—has become one of the nation's most important sources of natural gas since large-scale exploration and development were started about 5 years ago.

The San Juan basin extends geographically from its vortex near Farmington, N. M., into parts of the neighboring states of Colorado, Utah, and Arizona. All producing gas wells, however, are located in New Mexico and Colorado at the present time.

The location of the basin, with its isolation and rugged terrain, have given rise to some of the toughest problems the industry has ever had to face. Because of adverse weather conditions much of the year and the type of production involved, it has been necessary to develop special equipment and methods to allow efficient operation.

Problem with roads . . . Access roads always present a problem when a new development area is opened. In the San Juan basin this problem was particularly acute. The production area covers several thousand square miles of extremely rough terrain.

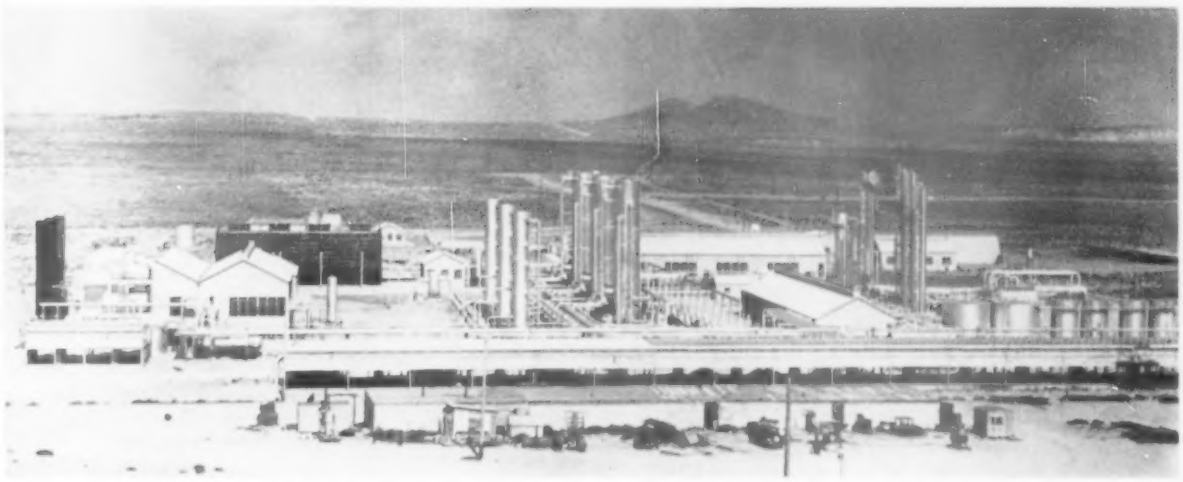
At the beginning of the major expansion, there were only three or four adequate roads in the entire area. In staking well locations, particular emphasis was placed on accessibility. Moving the location a very short distance would often shorten the access road several miles. Where such adjustments were not possible, it was sometimes necessary to resort to sidehill cuts and switchbacks in order to get a road into a location. Moving a rig from one location to the adjoining location often involved traveling several miles to avoid deep canyons. As the field developed, a system of roads was built to permit any part of the field to be reached quickly and easily.

A majority of the early wells drilled in the San Juan basin were completed in the Mesaverde formation. Early drilling experience indicated that this formation was difficult to drill with conventional rotary tools. Attempts to drill into this formation resulted in lost circulation and it was always doubtful whether or not gas could be produced from the formation after drilling in with mud.

It became standard practice to drill to the top of the Mesaverde formation using rotary tools. At this point the rotary tools were moved out and cable tools set up over the hole. The cable tools would then drill through the Mesaverde formation and complete the well using only water in the hole. This type of drilling was slow since the hole had a tendency to cave, and stuck tools and fishing jobs were common occurrences. The average well took 20 to 30 days to drill in after the cable tools were moved in.

Drilling with gas . . . In 1951 an El Paso Natural Gas Co. rig drilled into the Mesaverde formation with rotary tools, using gas to blow the cuttings out of the hole. This experimental rig drilled from the top of a Mesaverde to completion in less than 30 hours. The results on this well were highly encouraging.

Arrangements were made immediately to use this method of drilling on other wells. The result was a new procedure of drilling for wells completed in the Mesaverde formation. The conventional rotary rig drilled to the top of the formation, using mud. Instead of switching to cable tools at this point, the hole was simply cleaned out and



OVER 1,000 MILES of gathering lines supply plants like this one at Kirtland, N. M. Here the gas is treated, stripped of liquid hydrocarbons, and dehydrated before it enters transmission lines.

Natural Gas . . . Natural-Gas Pipelines

the rig switched to gas as a drilling medium to complete the well. This resulted in a saving of about 20 days in time and the expense of moving in cable tools.

Of the 600 plus Mesaverde wells tied into El Paso Natural's gathering system, over 350 were drilled in with gas.

After the well was completed in the Mesaverde formation, some method of opening up the formation to enhance gas flow was needed. Since the formation is a shale-sandstone structure, it is not susceptible to acidizing. The original procedure was to string shoot the entire Mesaverde formation with approximately 2,400 qt. of nitroglycerin. Such a charge naturally caused considerable shattering in the formation. The shale sections are normally unstable, and after the shot, they were very apt to cave.

This tendency to cave aggravated the cleanout problem. After wells were put on production, additional caving often blocked the well bore. Many times it was necessary to move in a cleanout rig and work the well over because of this caving. This was expensive from the standpoint of lost production in addition to the labor and equipment involved.

Hydraulic fracturing . . . In 1953 a well was completed by Sand-Frac. The results of this venture were very satisfactory and shooting was immediately replaced by fracturing as a completion procedure. This has resulted in a faster, cleaner, and more economical completion method. The 140 wells that have been completed in this way show a higher level of production with less tendency to plug.

Weather a Big Factor

Weather conditions gave rise to several operating problems in this area. With temperatures as low as —20° F. it is obvious that any water produced with the gas is subject to freezing. Separators set at the wellhead could remove this water from the gas, but these separators in turn became sources of trouble since the water would freeze in the controls and dump lines.

Downstream of the separators the gas cools rapidly, causing water to condense out in the lines. This water, in turn, could either cause hydrate formation or plain ice. It soon became obvious that burying the lines deep enough to prevent hydrate formation was impractical since the ground temperature was as low as 40° F. at a depth of 6 ft. Obviously drips and water legs were subject to freezing or hydrate formation because of the low ground temperatures. The only solution seemed to be removal of water at the wellhead by a combination of separation and dehydration.

Drying methods . . . The original dehydrator-separator installation consisted of a gas heater, a separator, and a dehydrator in series. These units were spaced about 75 ft. apart. We had learned that the gas would travel about 100 ft. from the wellhead before its temperature dropped to the hydrate point. This wellhead temperature was used to carry the gas to the heater.

After heating, the gas passed through the separator where water and liquid hydrocarbons were removed. Between the separator and the dehydrator, there was considerable temperature drop. Liquid water and hydrocarbons were condensed out and accumulated in this line. This liquid was carried into the dehydrator in slugs and caused considerable upset in these units.

To overcome this problem, the dehydrator was moved to a point immediately downstream of the separator. With this arrangement, it became obvious that the heater was not necessary if the dehydrator-separator combination was located near enough to the wellhead. The final arrangement was a dehydrator and separator mounted on a common skid and located about 75 ft. from the wellhead.

All-weather units . . . After mounting the dehydrator and separator on the same skid, steps were taken to winterize the separator. Heat was available from the hot glycol leaving the regeneration reboiler on the dehydrator. Heat exchangers were installed on the water-dump line between the separator and the dump valve. Coils were installed in the water section of the separator. Hot glycol was pumped through these heating elements to keep the water temperatures above freezing.

The pumps on the dehydrator were driven by gas that exhausted to the atmosphere. This gas was heated and then exhausted through the water dump

THE AUTHOR

W. W. Mize is senior engineer of El Paso Natural's San Juan division. He graduated in 1941 from Texas Technological College and joined the company that same year as a chemical engineer. He spent 4 years with the Navy during the war as a civilian employe, coming back to El Paso Natural in 1946. He moved to Farmington in 1951 to take up his present position.

lines to keep these lines warm. Dehydrated gas from downstream of the dehydrator was used to operate all instruments and controls. The result was a winterized dehydrator that has operated satisfactorily in extremely cold weather and that has kept flow lines free of freezing on all wells equipped with these units.

Disposing of Liquids

The wells in the San Juan basin are properly classified as gas wells; however, they produce some liquid hydrocarbons. The liquid production varies from a high-gravity low-boiling point material to a low-gravity waxy crude.

When the liquid production became a significant quantity, a market was developed and a system of gathering inaugurated. Trucks have been used exclusively for moving this liquid. As more and more wells began producing liquids, arrangements were made to pick this liquid up at wellhead and move it to central storage areas by trucks especially equipped for field hauling. The buyers' trucks could then load at these central storage areas and haul the liquid on into the refineries. In some instances, where the wells are easily accessible from the main highways, the liquids were sold at the wellhead.

Oil treating . . . Heavier oils produced in the San Juan basin are quite waxy and emulsify with water very readily. The resulting emulsion will stand in the storage tanks for days during the winter months without any indication of separating. The application of heat, however, will break these emulsions quite easily.

Chemical emulsion breakers are ineffective at the lower temperatures and are not necessary when the oil is warm. This oil is heated in special storage tanks built with a direct-fired heater in the bottom and equipped with water-drawoff connections.

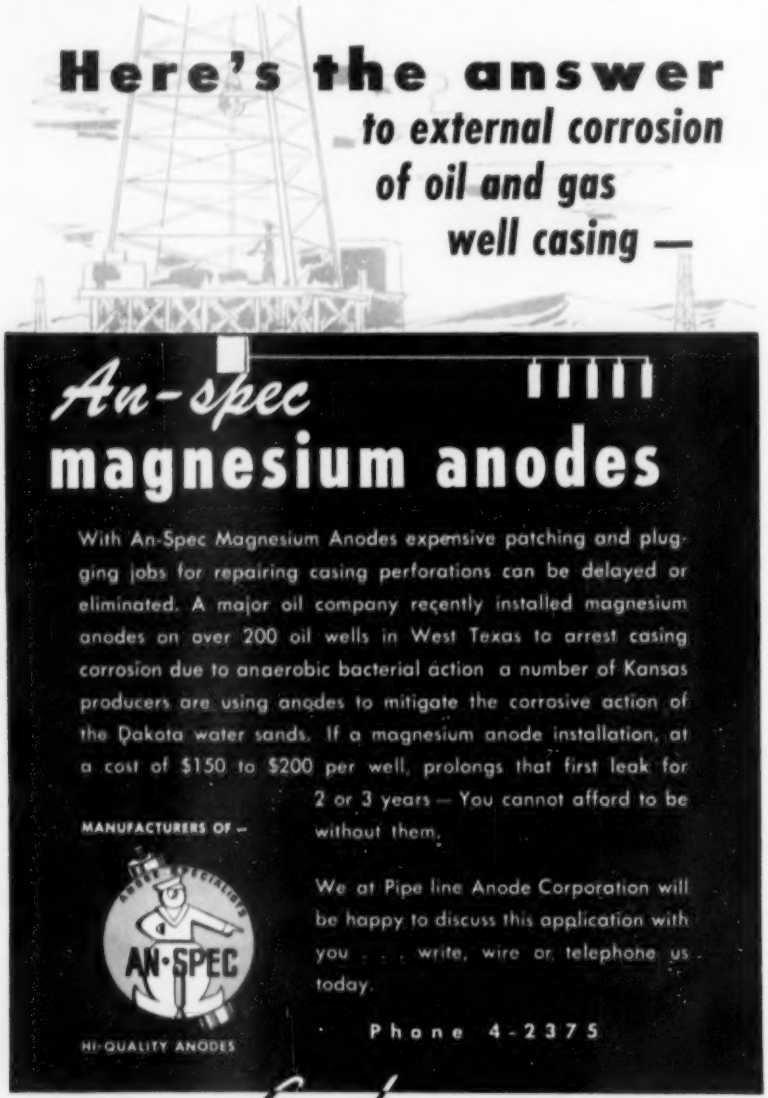
On extremely bad wells where the emulsion cannot be removed from the tank in the wintertime, these heater tanks are installed at the wellhead. On other wells, where the emulsion will flow, the oil-water emulsion is hauled to a central storage where large heater tanks are used to treat it.

In either case, when the tank is full, the heater is lit and the temperature of the oil is raised to about 100° F. The heater is thermostatically controlled and requires no attention during the heating period. By the time the oil temperature reaches 100° F., the water will separate and can be drawn off the bottom of the tank.

Special heater-treaters . . . The quantity of oil that can be treated in these heater tanks is somewhat limited. As the production in the field increased, these tanks gradually became inadequate. On some wells that produced a relatively high quantity of oil, it was found desirable to install conventional heater-treater on the separator dump lines.

Aside from these wells, the problem resolved itself into the need for a rapid and continuous means of treating oil at the central storage areas. A unit was devised for this purpose that was a compromise between the heater tanks and a standard oil treater. This unit was designed similar to a standard oil tank with a sealed top. A direct-fired heater with a high B.t.u. input rating was installed in the bottom section. The oil is introduced into the bottom of the unit under the fire box. As the liquid rises it is heated and the water separates and settles back to the bottom.

An internal baffle arrangement allows the water to be removed automatically by a differential pressure valve. The oil rises to the top and overflows into the storage tank.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Why M.E.A. Solution Breaks Down In Gas-Treating Service

by L. D. Polderman,* C. P. Dillon,* and A. B. Steele†

MANY gas-treating plants operate for long periods without undue difficulties. But some plants have serious problems with corrosion and solution contamination.

- Why? . . . to find some of the answers, Carbide & Carbon Chemicals Co. has been running a research program at Mellon Institute. The firm has found that M.E.A. can be converted to two other degradation compounds which do not accept acid gases.

- The carbonate salt of one of these compounds contributes somewhat to liquid-phase amine corrosion. It is not, however, the sole or major agent responsible for equipment failure.

- The degradation products are successfully removed in the usual commercial practice by distillation of a slipstream of the M.E.A. solution.

Monoethanolamine is an organic base having an ionization constant of 3.0×10^{-5} at 68° F. Its dissociation is in range of ammonia. It has the property of reacting with weak acids such as hydrogen sulfide and carbonic acid at ambient temperatures forming salts which decompose when heated to approximately 225° F., thus liberating monoethanolamine and providing an economic cyclic process for absorbing acid gases.

Substantially all hydrogen sulfide and carbon dioxide removal from natural and refinery gas in the United States today is accomplished by means of monoethanolamine and diethanolamine. In addition to the use of a monoethanolamine-water solution for desulfurizing gas, it is possible to use a mixture of suitable glycols and ethanolamines in order to accomplish simultaneous dehydration and desulfurization.

Solution deterioration . . . Experience with both aqueous and glycol-type monoethanolamine solutions in natural-gas-treating operations shows that in some plants the solution gradually loses capacity to absorb acidic gases and may become corrosive. While many plants have operated for years without such difficulties, other plants have experienced significant deterioration of the solution within several months after startup.

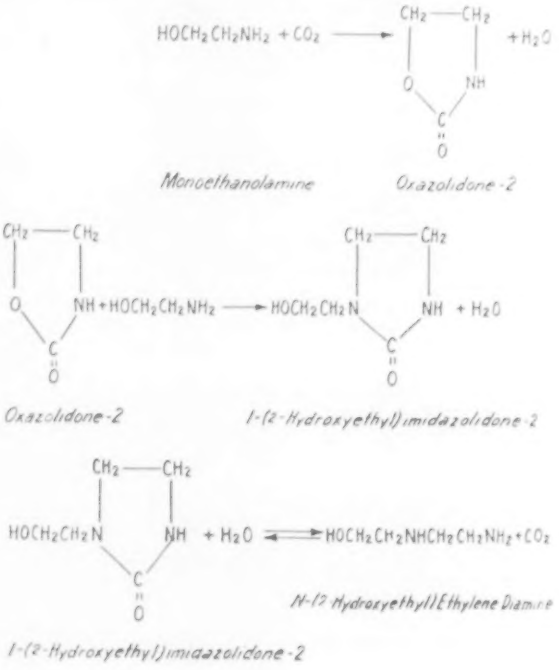
Carbide & Carbon Chemicals Co. has laboratory facilities at the Mellon Institute of Industrial Research in Pittsburgh where studies on the deterioration of monoethanolamine solutions have been in progress for several years. The information which has been developed may aid in better understanding the complex problems of corrosion and solution contamination encountered at some locations. While the work is not yet completed and much remains to be learned, it appears in order to submit at this time a preliminary report of our findings.

Capacity decline . . . Losses of monoethanolamine from scrubber solutions are often based on the observation that the solution progressively declines in capacity to accept acid gases. Chemical analyses, by titration methods, show the decline in capacity is accompanied by a decrease in the available monoethanolamine, but by other analytical procedures such as Kjeldahl and Van Slyke determinations the solutions would appear to contain more monoethanolamine than is actually present. These findings suggest that part of the monoethanolamine is not being lost from the system but is being converted to a form incapable of serving as an absorbent for acid gases.

Degradation Products

Examination of used aqueous and glycol-amine solutions led to the isolation and identification of two monoethanolamine conversion products, namely, 1-(2-hydroxyethyl) imidazolidone-2 and N-(2-hydroxyethyl) ethylene diamine. We have found that monoethanolamine can be converted to these compounds simply by heating the carbonate salt of the former at temperatures encountered in gas treating plants.

In the process it appears that monoethanolammonium carbonate is converted to oxazolidone-2 which, in the presence of monoethanolamine, converts to 1-(2-hydroxyethyl) imidazolidone-2; the substituted imidazolidone hydrolyzes to N-(2-hydroxyethyl) ethylene diamine and carbon dioxide:



*Carbide & Carbon Chemicals Co., and †senior fellow, Mellon Institute of Industrial Research, Pittsburgh.

The physical and chemical properties of the two conversion products, compared with similar properties of monoethanolamine, are listed in Table 1.

Consideration of the foregoing information indicates that in degraded solutions the monoethanolamine contents calculated from Kjeldahl nitrogen determinations should be expected to be higher than the amount of monoethanolamine present as such in the solution. The substituted imidazolidone contributes no basicity nor acid gas absorbing capacity to the solution even though it contains organic nitrogen: 21.4 per cent nitrogen compared with 22.9 per cent nitrogen in monoethanolamine.

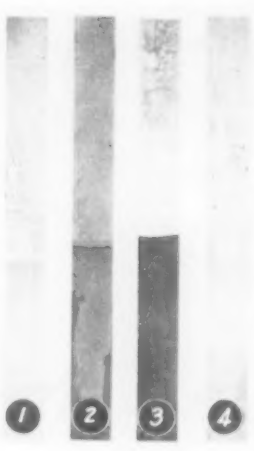


Fig. 1

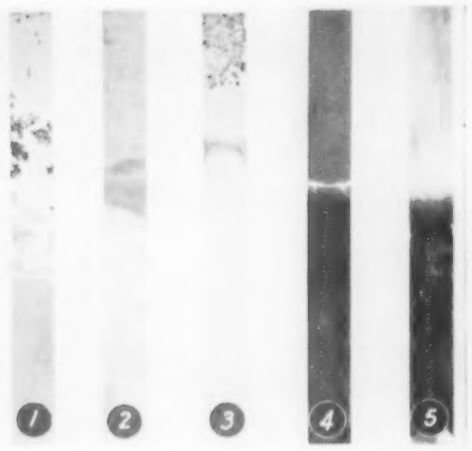


Fig. 2

QUALITATIVE CORROSION tests on carbon-steel coupons immersed in various glycol-amine solutions are shown in Fig. 1, and those in aqueous M.E.A. solutions in Fig. 2.

Analysis . . . The hydrolysis of the substituted imidazolidone to N-(2-hydroxyethyl) ethylene diamine restores part of the lost alkalinity and acid gas absorption capacity of the solution. However, because the ethylene diamine derivative is a stronger base than is monoethanolamine, it is more difficult to regenerate the sulfide and carbonate salts of the former and, in plant practice, a significant portion of the diamine remains in unregenerated salt form. The nitrogen content of the substituted diamine will appear in Kjeldahl and one of the nitrogen atoms in Van Slyke determinations. Both nitrogen groups in the molecule are titrated with standard acid; thus further complicating the interpretation of analytical values.

Equilibrium reaction . . . It should be noted that the hydrolysis of 1-(2-hydroxyethyl) imidazolidone-2 to N-(2-hydroxyethyl) ethylene diamine is an equilibrium reaction. Our studies have shown that the equilibrium is profoundly influenced by the temperature and partial pressure of carbon dioxide in the aqueous systems. Thus, in monoethanolamine scrubber solutions which have been operated in such a way as to promote conversion of monoethanolamine to 1-(2-hydroxyethyl) imidazolidone-2, one should expect to find N-(2-hydroxyethyl) ethylene diamine as an additional contaminant, the concentration of which will depend upon the imidazolidone content of the fluid, the distribution of acidic components in the gas stream, and the operating temperatures and pressures of the treating units.

Effect on Operation

The isolation and identification of these two monoethanolamine degradation products leads to the consideration of the effect of their presence in plant solutions. The formation of imidazolidone will lead to a reduction in the effective monoethanolamine concentration and increase the viscosity of the solution. If its concentration reaches sufficiently high values it may aggravate the precipitation of residues in portions of the equipment. While it does not absorb acid gas its presence does not significantly interfere with the absorption of such materials by the remaining monoethanolamine. N-(2-hydroxyethyl) ethylene diamine will pick up acid gases, but release them only with difficulty.

Slipstream distillation . . . Commercial experience proves that it is possible to remove the imidazolidone from fouled plant solutions by means of distillation equipment operating at atmospheric pressure on a side stream of the circulated solution. Batchwise operation handling approximately 1 per cent of the circulated solution has been successful. Vacuum distillation equipment has been equally successful in the case of glycol-amine solutions. While the substituted ethylene diamine can be efficiently removed in aqueous monoethanolamine systems, it cannot be removed from diethylene glycol-monoethanolamine mixtures as its boiling point is within a few degrees of that of diethylene glycol.

However, as the imidazolidone and substituted diamine are in equilibrium in these solutions, successful removal of the imidazolidone results in an ultimate removal of substituted diamine from the scrubber fluid. Plant practice has confirmed that removal of the 1-(2-hydroxethyl) imidazolidone-2 results in the gradual disappearance of N-(2-hydroxethyl) ethylene diamine from the plant solution.

Corrosion tests . . . Preliminary laboratory corrosion tests indicated that the substituted diamine carbonate salt contributed somewhat to the corrosiveness of amine solutions. The diamine itself was not found to significantly promote attack.

Fig. 1 shows qualitative corrosion tests on carbon-steel coupons immersed for 350 hours at 255° F. in various glycol-amine solutions:

1. Control solution—15 parts monoethanolamine, 76.5 parts diethylene glycol, and 8.5 parts water. Carbonated; mole ratio CO_2/base = 1/10.

2. Used plant solution (completely

TABLE 1

Properties	Monoethanolamine	N-(2-hydroxyethyl)-ethylene diamine	1-(2-hydroxyethyl)-imidazolidone-2
Physical state	Viscous liquid	Viscous liquid	White crystalline solid
Solubility	Miscible with water in all proportions		
Equivalent Wt. by titration with HCl	61	52	Not alkaline
Melting point, °C	10.5		56.5
Boiling point, °F			
at 760 mm.	340	470	dec.
at 10 mm.	156	261	
at 0.1 mm.	45		360
Elemental analysis, % by Wt.			
carbon	39.4	46.1	46.1
nitrogen	22.9	26.9	21.4
oxygen	26.2	15.4	24.8
hydrogen	11.5	11.5	7.7

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regenerated in the laboratory). Carbonated as in (1).

3. Control solution contaminated with 2 per cent N-(2-hydroxyethyl) ethylene diamine. Carbonated as in (1).

4. Control solution contaminated with 2 per cent 1-(2-hydroxyethyl) imidazolidone-2. Carbonated as in (1).

Fig. 2 shows qualitative corrosion tests on carbon-steel coupons immersed for 350 hours at 255° F. in various aqueous monoethanolamine solutions:

1. Used plant solution (completely regenerated in the laboratory).
2. Control monoethanolamine solution (13 per cent in water).
3. Control monoethanolamine solution (15 per cent monoethanolamine in water). Carbonated; mole ratio CO_2/base = 1/10.
4. Solution 1. Carbonated as in (3).
5. Solution 2. Carbonated as in (3).

Quantitative tests . . . The discovery that the presence of the substituted diamine in carbonated monoethanolamine solutions influenced the corrosiveness of the mixture in qualitative tests lead to a quantitative study of the effect of the contaminants at our Texas City Corrosion Laboratory. It appears impossible to devise static laboratory tests that will reproduce the corrosion pattern found in industry as some installations have operated satisfactorily for extended periods with all carbon steel equipment while others have encountered serious attack within a year or less on heat transfer areas.

The fact that widely divergent corrosion experiences are found even in plants operating under somewhat similar conditions indicates that carefully conducted pilot plant studies are probably required to evaluate the many factors influencing corrosion in amine systems. It is suggested, therefore, that the following information be considered only to be exploratory in nature and indicative of the possible effects of the contaminant on plant corrosion. The laboratory test conditions were intentionally severe and probably indicate penetrations considerably higher

TABLE 2

Test conditions		Liquid phase penetration in inches per year	
Temp. (°F.)	Mole ratio CO_2/M.E.A.	20 Per cent M.E.A. in water	20 Per cent M.E.A. in water plus ½ per cent H.E.E.D.
250	0.6	0.021	0.015
	0.45	0.008	0.015
	0.3	0.016	0.015
	0.2	0.006	0.004
		Avg. 0.013	Avg. 0.012
275	0.6	0.041	0.094
	0.45	0.021	0.024
	0.3	0.022	*0.039
	0.2	0.017	0.033
		Avg. 0.025	Avg. 0.048
300	0.6	0.056	0.039
	0.45	0.024	0.037
	0.3	0.025	0.053
	0.2	0.020	0.062
		Avg. 0.031	Avg. 0.048

*At 5 per cent N-(2-hydroxyethyl) ethylene diamine, 0.060.

TABLE 3

Test conditions		Vapor phase penetration in inches per year	
Temp. (°F.)	Mole ratio CO_2/M.E.A.	20 Per cent M.E.A. in water	20 Per cent M.E.A. in water plus ½ per cent H.E.E.D.
250	0.6	0.004	0.014
	0.45	0.018	0.019
	0.3	0.015	0.001
	0.2	0.001	0.002
		Avg. 0.010	Avg. 0.009
275	0.6	0.003	0.030
	0.45	0.014	0.016
	0.3	0.013	0.008
	0.2	0.003	0.002
		Avg. 0.008	Avg. 0.014
300	0.6	0.013	0.021
	0.45	0.010	0.007
	0.3	0.013	0.008
	0.2	0.005	0.008
		Avg. 0.010	Avg. 0.011

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GENERAL PIPE LINE CONSTRUCTION

than found in heat exchanger or reboiler service in most plants.

The tests were run in an electrically heated stainless-steel container held at 40 psig. by the regeneration of carbon dioxide from the solution and the addition of the necessary amount of supplementary nitrogen to maintain the pressure. The mole ratios of carbon dioxide to monoethanolamine were 0.6, 0.45, 0.3, and 0.2 on the basis of the acid gas and amine charged into the vessel.

Test results . . . It should be mentioned that earlier tests at 300° F. in the same apparatus but in the absence of acidic gas indicated that a 20 per cent monoethanolamine solution is less corrosive towards steel than is water. For example, the liquid phase attack was reduced from 0.054 to 0.010 in. of penetration per year (i.p.y.) and vapor phase penetration from 0.079 to 0.003 i.p.y. in the presence of 20 per cent monoethanolamine. The effect of carbon dioxide was also evaluated at 300° F. and 40-psig. pressure and the tests indicated that the attack in monoethanolamine-water-carbon dioxide systems is due primarily to the acid gas itself. In a 20 per cent monoethanolamine solution, for example, the substitution of carbon dioxide for nitrogen increased the liquid phase corrosion from 0.010 to 0.056 i.p.y. and the vapor phase attack from 0.003 to 0.013 i.p.y.

The data obtained in the presence of 0.5 and 5.0 per cent N-(2-hydroxyethyl) ethylene diamine are shown in Tables 2 and 3.

Liquid phase . . . The data show an average liquid phase penetration of 0.023 i.p.y. in the absence of N-(2-hydroxyethyl) ethylene diamine as compared with 0.036 i.p.y. with ½ per cent present indicating the contaminant increased the rate of attack approximately 50 per cent. The most pronounced effect is at the higher temperatures, probably because of the ability of N-(2-hydroxyethyl) ethylene diamine to retain carbon dioxide at higher temperatures than does monoethanolamine.

Vapor phase . . . In the vapor-phase studies the average penetration increased from 0.009 to 0.011 i.p.y. or approximately 20 per cent when ½ per cent N-(2-hydroxyethyl) ethylene diamine was present indicating that at low concentrations the contaminant will probably exert little influence on the rate of corrosive attack on the vapor area of plant equipment.

- In summary, 1-(2-hydroxyethyl) imidazolidone-2 and N-(2-hydroxyethyl) ethylene diamine have been isolated and identified as degradation products of monoethanolamine in many samples of used plant solutions of both the aqueous and glycol-amine types. Many plants, however, operate for years without the formation of these products.

- The use of side stream distillation equipment successfully effects their removal in plant practice.

- Laboratory corrosion studies indicate that the presence of monoethanolamine reduces the vapor phase attack of carbon steel in water-carbon dioxide systems and that the acid gases themselves are the primary corrodents in uncontaminated solutions. Carbonated N-(2-hydroxyethyl) ethylene diamine at concentrations in the range of ½ to 5 per cent contributes measurably to liquid phase corrosion in laboratory tests although laboratory data and commercial experience both indicate that it is not a violent corrodent alone responsible for the rapid failure of plant heat exchanger equipment.

Reference

1. Acidic Dissociation Constant and Related Thermodynamic Quantities for Monoethanolammonium Ion in Water from 0° to 50° C.; R. G. Bates and G. D. Pinching, J. of Research, National Bureau of Standards; 46, No. 5, 349-352, May 1951.

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"Packaged" Compressor Plants Have Come of Age

by J. M. Lane

PACKAGED compressor plants reached their "maturity" in 1953-1954 as evidenced by their wide acceptance throughout the gas industry. This type equipment can do an excellent job at a relatively low installed cost and it has unusually high salvage value.

Operators confronted with gas problems of a "temporary" nature have long yearned for an easy and inexpensive solution. They needed equipment which was readily available, easily transported, quickly installed, automatic in operation, and easily removed once it had served its purpose. The packaged compressor plant solved the problem in this case. And quite often the resulting savings from quick installation and inexpensive operation paid for the plant during only part of its "temporary" life.

One application of this type is the conservation of gas cap or excess production from new oil wells. Most states have regulations which prohibit flaring of gas. In many states the rate of allowable oil production is limited only by the producer's ability to make satisfactory disposal of the gas in a manner which is not wasteful. If there is a commercial outlet nearby, frequently the gas can be compressed, treated for removal of liquids, and sold to the outlet at his specification regarding pressure and temperature.

When such an outlet is not available, many times it becomes feasible to compress the gas and pump it back into the reservoir to maintain pressure of the formation and thus prolong life of the well or field. Increased production rate resulting from such treatment of the gas early in the life of a field often will pay out the cost of the compressor plant in an unusually short period of time.

Author is associated with Stearns-Roger Manufacturing Co.

Another use is in gas-lift operations. The theory in this instance is that residue or surplus gas is compressed to high pressure and injected so that it actually blows much of the remaining oil out of the well. This method is particularly effective in fields where deep wells are found. Often difficulties are encountered in pumping a deep well because of mechanical limitations inherent in the pumping equipment itself, and a gas-lift program will thus eliminate problems of this type.

Gathering and production . . . Undoubtedly the greatest single use of packaged compressor plants has been found in the production and gathering of gas. Gas-gathering lines in the oil fields represent an ever-increasing investment. As new fields are discovered and older ones deepened or enlarged, the problem of proper sizing for such lines is extremely complex. Pressures have a natural tendency to decrease as wells continue to produce. A line designed to flow a given amount of gas at today's production pressure can very easily prove inadequate next year or 5 years from now at naturally reduced wellhead pressures.

Replacement of the gathering system each time a significant pressure drop occurs is, of course, out of the question from an investment standpoint. It is equally difficult to design a system which will afford an average degree of satisfactory performance under changing conditions. In this situation the packaged compressor plant again offers a remedy. The plant can serve one well or a group of wells depending upon the physical location. And its discharge pressure can be preestablished at a design pressure which gives the desired flow at the most economical gathering-system line size.

Fluctuating suction pressures (due to decreased wellhead pressures caused by depletion) can be compensated for in advance by installing clearance pockets in the compressor cylinders. If pressure drops through the years are too great to be entirely cared for in this manner, the compressor cylinders can be readily changed to satisfy new conditions. It may also be desirable to add additional compressor facilities so that desired flow can be maintained. These changes or additions can be done at a small price compared to the cost of replacing the entire gathering system.

Processing . . . Many systems of gas-gathering lines lead to a more centrally located gas-processing plant. The processing equipment in such plants is necessarily limited in flexibility. Consequently, it becomes of prime importance to maintain design conditions with minimum fluctuation. Gathering systems implemented by the use of packaged compressor plants accomplish this purpose easily, and assure economical operation of the processing plant continually under design conditions. The economic return to the operator has increased twofold—by maximum economical design of his gathering system, and by predictable production from his processing plant even though wellhead gas pressures continue to decline in the usual normal way.

Natural Gas . . . Natural-Gas Pipelines

In addition to all this, each passing day discloses an even greater use for the packaged compressor plant in completely new or previously untried applications. A definite trend has been established toward the use of these units in compressor operations as integral portions of gas processing plants of all types. They do the job as well as conventional-type installations previously did it, yet their installed cost remains significantly lower.

It is strongly felt that the packaged compressor plant will play an important role in new techniques such as the use of high-pressure gas in the drilling of oil wells. The field for application is very wide because of the equipment's flexibility and the ease with which it can be moved to new locations or altered for different service conditions.

Portability . . . The packaged unit is merely a combination of all components normally required for compressor-plant operation. But it is condensed and compacted so that they all can be placed on a skid of small enough dimensions to insure comparative ease of handling.

Portability of the entire unit is demonstrated by the continued shipment by truck of units weighing in excess of 80,000 lb. from Denver to Rangely, Colo. The 300-mile route covers some of the most mountainous terrain in the country. Loveland Pass at an altitude of 11,992 ft. and Vail Pass at an altitude of 10,603 ft. must both be reckoned with as the truck climbs its way over the backbone of the nation.

Despite this obstacle it is a routine practice for the units to be delivered in Rangely on the day after the shipment originates in Denver! Dawn to dark travel only is permitted.

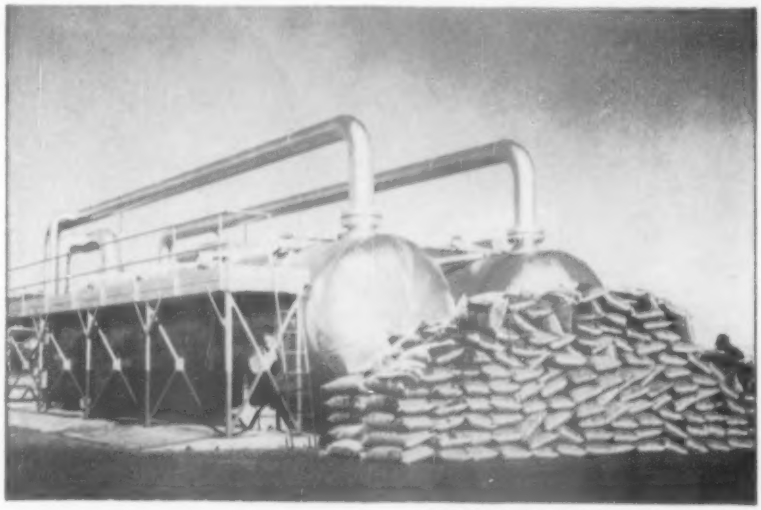
Specific design . . . Each unit demands all of the engineering inherent in any compressor plant regardless of size. Scrubbers, piping, cylinders and all other equipment and instrumentation are specifically designed for the operator's particular problem. Physical design enables the fabricator to assemble all necessary items into space limits imposed by the portability factor.

In addition, the skid is designed to withstand not only its static load and the stresses caused by handling during shipment, but also forces acting on it during actual operation. The skids can be designed so that it no longer is necessary to install large masses of concrete blocks and mats. The only concrete necessary is a thin mat which also can serve as foundation for any shelter the operator may wish to install as protection for the unit.

This characteristic of the packaged unit is responsible for the largest single economy of installation. The concrete is sharply less in quantity and simpler in form. The complete packaged unit, carrying all of its own auxiliaries, can be set in place on its foundation in less time than is normally required to set the compressor engine alone. This, too, results in lower installation costs.

Instrumentation . . . The packaged plant contains adequate instrumentation to assure its safe and proper operation. The compressor itself has shutdown devices, such as overspeed, overload, high jacket-water temperature, high oil temperature, and low oil pressure. The piping and all equipment through which gas flows are protected by safety valves. And even though places where liquids may accumulate are provided with continuous automatic drainers or traps, a float-type shutdown device is also installed to protect the unit in the case of drainer failure.

Primary and secondary fuel-gas regulators are provided so that high-pressure gas can be utilized as fuel if necessary, and each unit contains its own



Gas dehydration units, San Juan Basin Plant

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Natural Gas . . . Natural-Gas Pipelines

fuel-gas volume reservoir. Liquid-level gages are installed on each scrubber as well as on the jacket-water surge tank. Pressure gages and thermometers are provided so that all critical pressures and temperatures will be properly indicated. Temperature controllers complete with three-way valves are installed in the jacket-water system and the lubricating-oil system to assure best operating conditions for the compressor. Adequate instrumentation makes it possible for the unit to travel unattended except for periodic operational checks and necessary maintenance work.

Coolers . . . A wide variety of coolers is available for installation on packaged compressor plants. These include vertical or horizontal designs incorporating either forced-draft or induced-draft fans. They can be provided for multiple service of cooling jacket water, lubricating oil, and gas—all in one piece of equipment using one fan. These coolers can be arranged for drive by belts from the compressor flywheel or by an independent drive such as electric motor.

Some units, however, are powered by a hydraulic system, the pump only of which is driven by belts from the engine flywheel. Jacket-water surge tanks for each cooler assure optimum operation of the water system, and frequently the systems are operated as a closed circuit by addition of a low-pressure relief valve which tends to prevent loss of cooling fluid. Each of the cooler types can be supplied with automatic or manually operated louvers for cold-weather installations if the operator desires this additional protection.

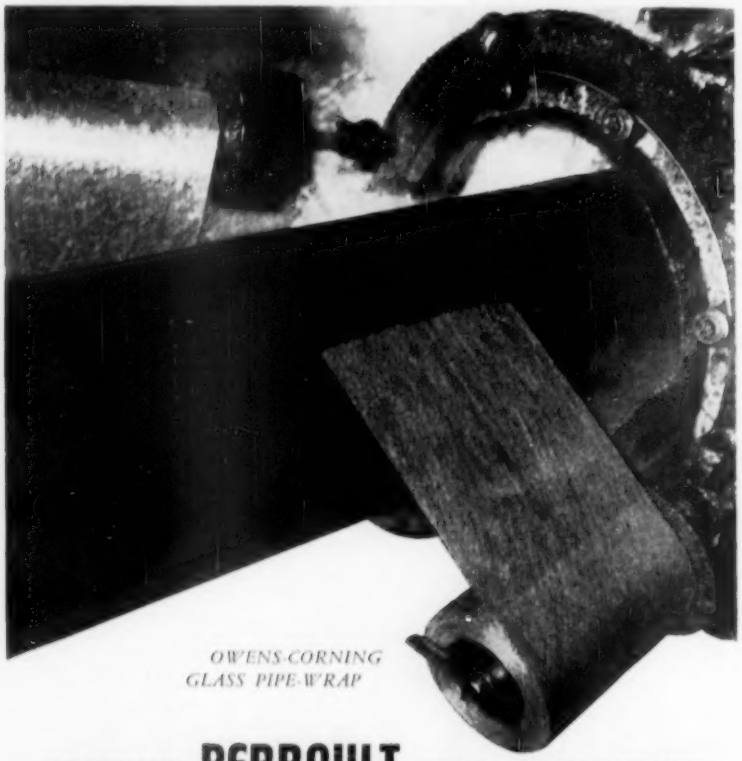
Accessories . . . A tank-mounted air compressor driven either by gas-gasoline engine or electric motor can also be supplied on the packaged unit so that the compressor will always have a source of starting air. Simple gas scrubbers are furnished on the suction stream of each compression stage to remove entrained liquids. Another accessory frequently desired by the operator is the lubricating-oil filter.

Scrubbers are designed in each case for the characteristics of the gas involved and are usually constructed in accordance with the A.P.I.-A.S.M.E. Code for Unfired Pressure Vessels. Many types of oil filters are available and practically all of them can be easily incorporated in complete unit.

Unfortunately, packaged plants cannot be stocked because there is no such thing as standard gas conditions. Compressor cylinders and auxiliary equipment cannot be procured until the specific gas characteristics of the problem at hand are fully known and understood. Certainly, adequate design must also consider elevation and climatic conditions where the plant is to be installed, as these factors play an important role in satisfactory field operation of the unit.

Gas engineers, however, are able to analyze the gas problem quickly once it is known, and to write specifications for the compressor cylinders. Auxiliary equipment is then specified and procured, mechanical engineering completed, and fabrication started. By the time the compressor cylinders are received by the fabricator his work is far enough along so that assembly is all that remains. Time has not been lost, though.

Packaged compressor plants offer reliable service on any application requiring compression of gas. The size of compressor is limited only by the ability of a carrier to transport it. Assembly of all components in a well-equipped shop offers substantial economy over installation of each of these components on its separate foundation under field construction conditions.



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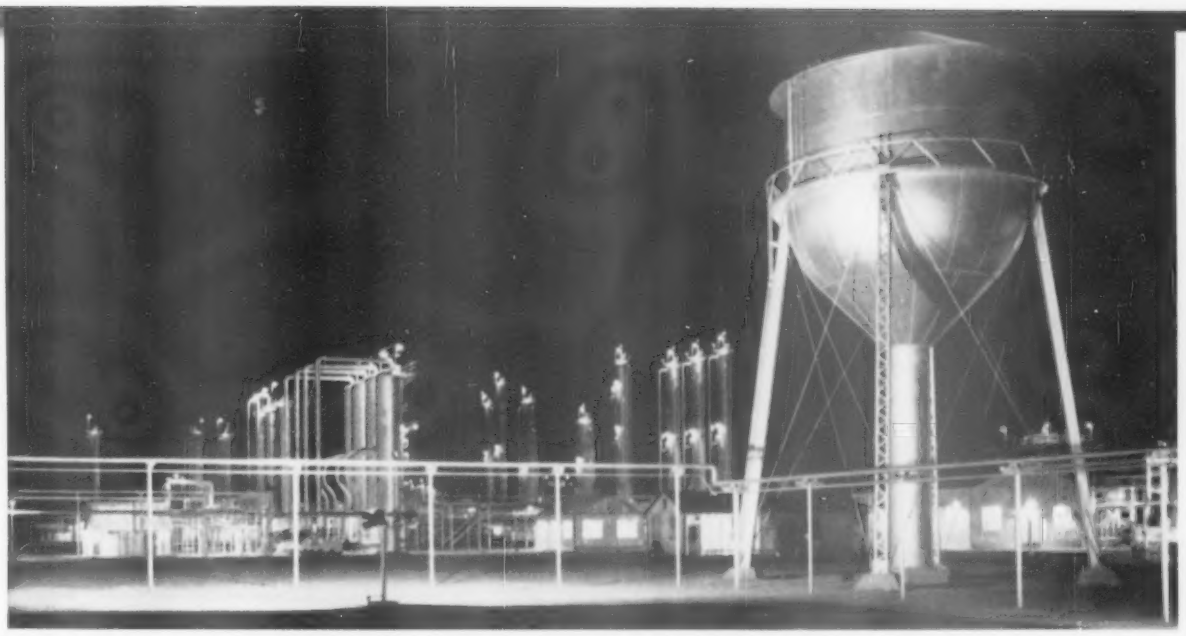

NIGHT VIEW of plant's dehydration area. Gasoline-plant vessels are in background. Buildings, left to right, house fuel measuring, laboratory and lean-oil pumps.

Permian Basin processing plant demonstrates

How to Design for Water Conservation

by R. B. McLaughlin and A. B. Richert

PERMIAN BASIN PIPELINE CO.'S Hobbs, N. M., gas processing plant was completed in March 1955. These facilities are designed to handle 170 M.M.c.f.d. of inlet gas and include acid-gas treating, dehydration, compression, and gasoline extraction.

Two major bases for design were conservation of water and an ultimate residue-gas capacity of 200 M.M.c.f.d. The vessels and piping were sized for the ultimate capacity.

Water conservation . . . To conserve water, air-fin cooling equipment was used extensively wherever possible. This resulted in using water only for final cooling of amine, lean oil, absorber intercooling, still final condensing, depropanizer condensing, and product cooling.

Gathering and residue gas system . . . Gas for the plant is gathered at approximately 425 psig. from 200 gas wells located in the Hobbs-Eunice area.

Gas treating . . . Plant inlet gas is treated for acid gas removal before compression. Gas-treating facilities are designed for 500-psig. contact pressure with 15 per cent methyl ethanolamine solution. Treating capacity is provided for 170 M.M.c.f.d. of raw gas containing 3 per cent acid gas. Foul amine is regenerated in a conventional type still using 30-psig. steam as a heating medium. Steam-generation capacity is 112,000 lb. per hour at 250 psig. Reducing the steam through turbines to 30 psig. provides the necessary power to drive the amine and boiler feed pumps.

Amine reactivator overhead condensing and initial amine cooling are done with air-fin cooling equipment. Tubes for these units are steel with aluminum fins. Final amine cooling is done with atmospheric cooling coils using bimetallic tubes of steel inside and admiralty outside. All vessels and reboiler shells are stress relieved and have ¼-in. corrosion allowance. Sidestream filtration and reclaiming equipment for the amine is used to keep the solution clean and noncorrosive.

To prevent contamination of the plant residue-gas discharge line, recording hydrogen sulfide analyzers are installed on the line from the treater and also on the plant residue line. The unit installed on the gas from the treater is equipped with an alarm which operates at high H_2S content. Also, the unit operates compressor shutdown devices when the H_2S content reaches the maximum allowed for main-line transmission.

Compression . . . Single-stage gas compression is required to increase the gas pressure from 400 psig. to the required transmission pressure of 800 psig. Four 1,320-hp. gas-engine-driven units were installed for this service. Cooling requirements for jacket water, lube-oil cooling water, and gas are fulfilled with air-fin cooling equipment.

Dehydration . . . Residue gas from the absorbers is dehydrated with solid-desiccant-type adsorption contactors using bauxite. Regeneration of the desiccant beds is accomplished at line pressure using a sidestream of gas heated by Dowtherm vaporizer units. Air-fin cooling equipment is used to cool the regeneration stream to condense the water before this gas returns to the main stream.

The dehydration unit is designed for a maximum pressure drop including regeneration not to exceed 4 psi. To reduce the regeneration stream volume, the desiccant vessels are insulated on the interior. A light-gage steel liner protects the insulation from desiccant abrasion. Use of Dowtherm as a heating medium permits the heating of the regeneration stream to 500° F.

Final bed temperatures of 450° to 475° F. can be attained. This maintains the bed adsorption efficiency for

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This new Gas Processing Plant was designed and built by DRESSER for Permian Basin Pipeline Company, a subsidiary of Northern Natural Gas Company. It is another example of DRESSER's ability to handle complete projects from inception; including Natural Gasoline and Liquefied Petroleum Plants — Desulfurization Plants — Compressor Stations — Solid and Liquid Dehydration Plants — Pipeline Pump Stations — Recycling and Pressure Maintenance Plants — Petroleum Industry Process and Construction.

MAY, 1955
REVIEW OF
PERMIAN BASIN PIPELINE COMPANY
HOBBS, N. MEX. PLANT
INCEPTION
Early in 1953 a decision was made by the Permian Basin Pipeline Company, a subsidiary of Northern Natural Gas Company, to build a Gas Processing Plant near Hobbs, New Mexico. DRESSER Engineering Company was awarded the contract.
Gas to be processed by the new plant would be gathered from 200 wells in the Hobbs-Eunice area.
This report is a brief recap of the development and construction of that plant. As is customary, DRESSER handled the project from Inception to Completion ... including evaluation of processes, design, purchasing and accounting, and construction

COMPRESSION — Four 1320 H.P. gas engine units were installed to increase gas pressure for pipe line transmission. Air fin coolers were used to cool jacket water, lube oil cooling water, and gas.

ABSORPTION, DISTILLATION AND FRACTIONATION — Propane, butane, and natural gasoline are absorbed from the gas, then stabilized and separated from the oil by distillation. The raw gasoline is then fractionated into components which are individually treated for mercaptan removal before going to storage.

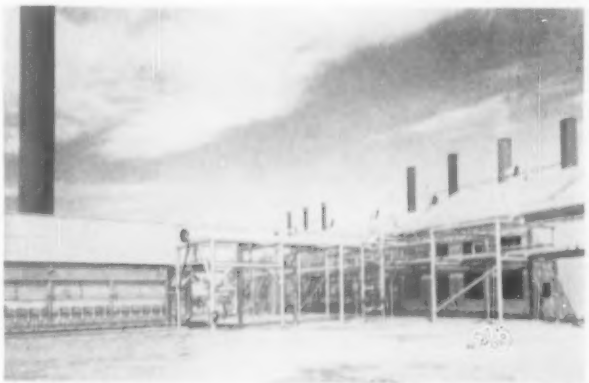
HISTORY

Design and construction of this new Gas Processing Plant began in June, 1953. Gas Treating, Dehydration and Compression facilities were placed in operation in December, 1953 and the Gasoline Plant in July, 1954. Facilities for increasing the capacity to 150 MMCFD were completed in October, 1954.

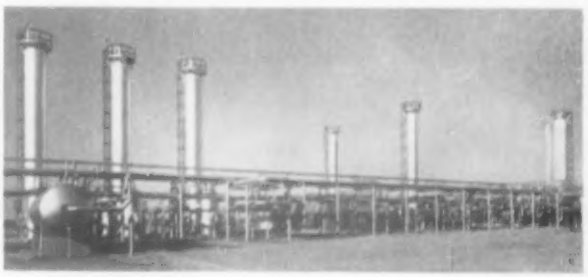
Two major premises for design were the conservation of water, and an ultimate residue gas capacity of 200 MMCFD. Air fin cooling equipment was used extensively, and major piping, oil distillation towers and product fractionators were sized for the ultimate capacity. All other vessels and accessory equipment were specified as 50 MMCFD capacity units.

In addition, DRESSER constructed warehouses for pipe line, field meter, and plant maintenance. A District Office building laboratory, and 13 homes for employees completed the project.

DRESSER's years of experience in evaluation of process, design and construction were instrumental in their being awarded this contract. Consider DRESSER for your next petroleum processing project.



BOILERS AND RICH OIL FURNACE — Steam power and process heat for the gas treating plant is furnished by four steam boilers with a total capacity of 120,000 lbs./hr. of steam. Process heat for the oil distillation and fractionation facilities is furnished by a large absorption oil heater. Dowtherm heaters furnish heat for gas dehydration regeneration.



GAS TREATING — Multiple amine-gas contactors and distillation units reflect steps in capacity growth of this plant, and give maximum flexibility for all load conditions.

DRESSER ENGINEERING COMPANY

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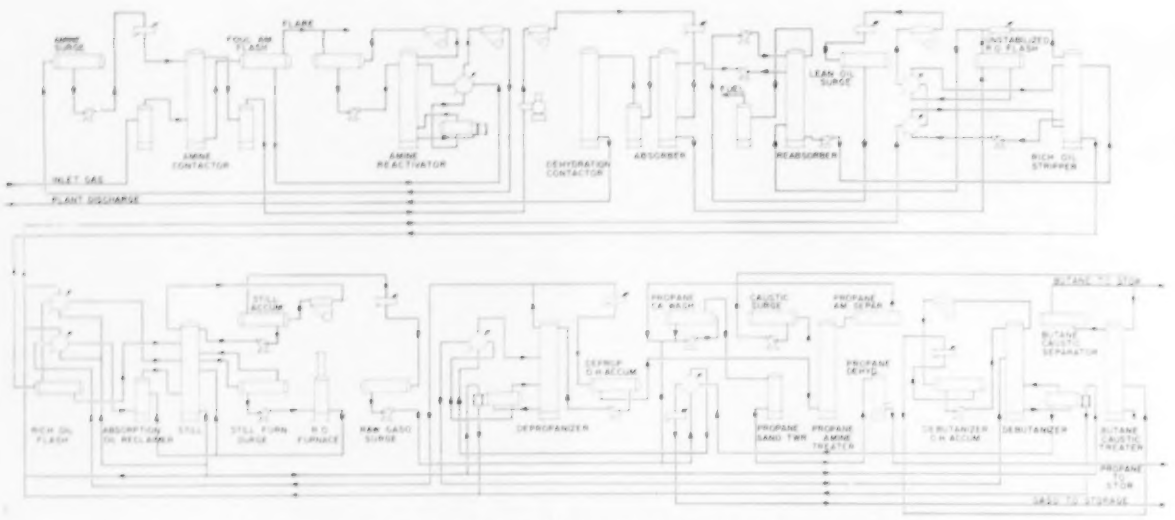


FLOW DIAGRAM of Permian's 200-M.M.c.f.d. processing and compressor plant.

Natural Gas . . . Natural-Gas Pipelines

a longer period of time and allows recovery of a large portion of absorption oil carried as vapor in the residue gas.

Absorption and distillation . . . Absorption of the desired hydrocarbon components is carried out in three conventional absorbers with an oil circulation rate of 600 g.p.m.

Rich oil from the absorbers is deethanized in a combination of two bubble-tray towers, one a 27-tray reabsorber and the other a 20-tray stripper operating at 165 psig. Rich oil is fed to the top of the stripper. Heat exchange with the liquid from the bottom tray and hot lean oil from the still furnishes the required heat for vaporization to provide stripping vapors for the deethanization of the rich oil.

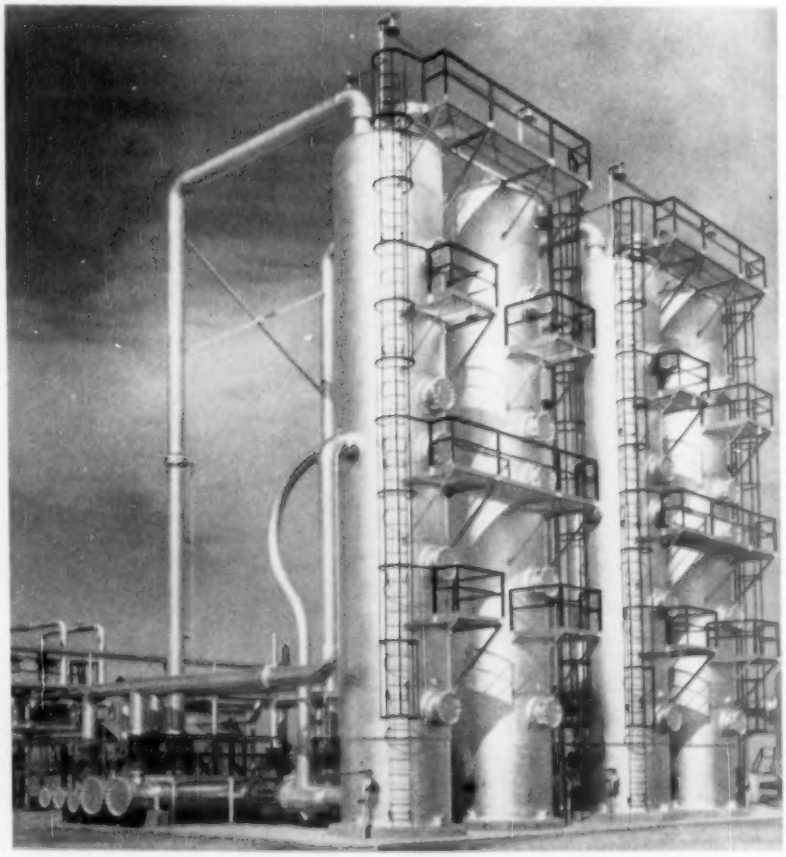
Cooled vapors from the stripper, along with vapors flashed from the rich-oil feed, are introduced into the reabsorber. Reabsorber lean-oil circulation rate is 100 g.p.m. Rich oil from the bottom of the reabsorber is pumped to the top of the stripper. Removal of all methane and substantially all of the ethane at this point permits total condensation of the still overhead vapor at 100 psig. Residue vapors from the reabsorber are used for plant fuel.

Hydrocarbon stripping from the absorption oil is done in a conventional-type still using hot hydrocarbon vapors as a stripping medium.

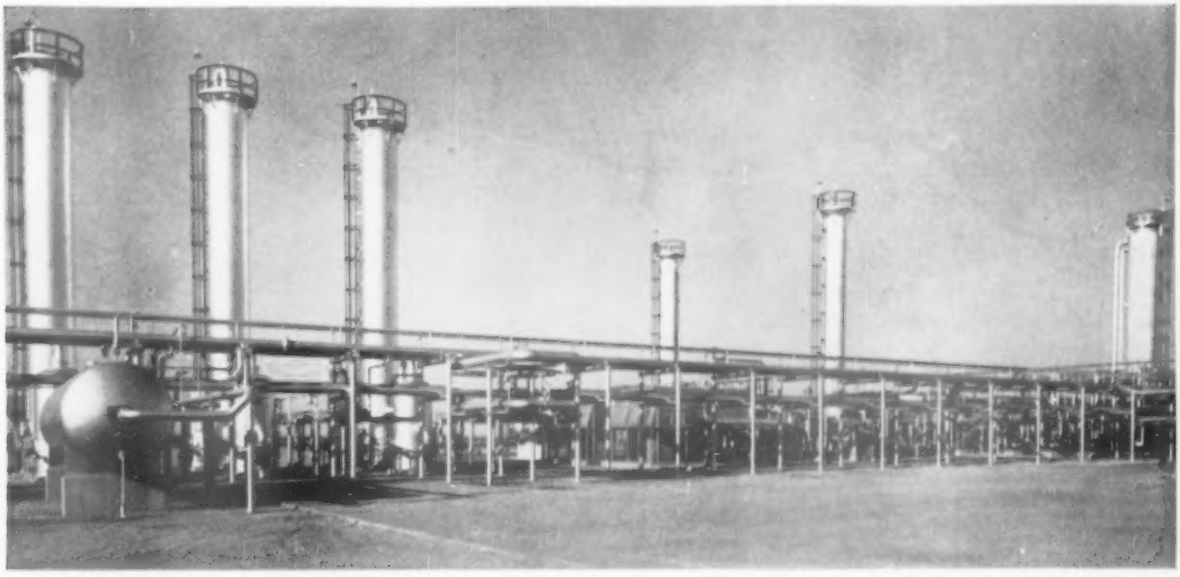
Oil reclaiming . . . Oil reclaiming is accomplished by taking a small sidestream of hot oil from the furnace and feeding to a two-tray reclaimer. Hot propane vapor is used to strip the oil leaving only the heavy ends. Stripping propane and oil vapor go directly to the bottom of the still.

Fractionation . . . The raw products from the still are fed to a conventional 40-tray depropanizer where commercial propane is made overhead. Depropanized product is fed to a 35-tray debutanizer where mixed butanes are made overhead. Natural gasoline, ranging from debutanized to 26-psi. R.v.p., is a bottom product.

Overhead vapor condensing on the depropanizer is accomplished with



THESE DEHYDRATION CHAMBERS use a solid bauxite desiccant and have a pressure drop including regeneration of only 4 psi.



INLET GAS TREATERS at left use methyl ethanolamine for removal of acid gas. Amine is regenerated in three towers at right

Natural Gas . . . Natural-Gas Pipelines

water and on the debutanizer with air-fin cooling equipment. Hot lean oil from the still furnishes all the process heat required by the fractionation system.

Product treating . . . To meet sulfur content specifications, both the propane and mixed butanes require treating to remove hydrogen sulfide and mercaptans. The hydrogen sulfide in the propane is removed with circulation of a small amount of 15 per cent methyl ethanolamine solution over a packed tower.

Mercaptans are removed by circulating caustic solution and mixing with the propane and by circulating caustic solution over a packed tower with the butanes. Regeneration of the caustic solution is obtained by stripping with steam in a packed tower. Gasoline-treating equipment consists of a Perco treater. The finished liquefied petroleum products are dehydrated.

Product loading . . . Loading facilities for products consist of a 2-place truck-loading rack, a 12-railroad-car loading rack, and pumping facilities for delivery of products to a pipeline. The truck-loading rack is located at the plant site and the railroad-car rack is located about 8 miles from the plant.

Water requirements . . . Water requirement is 110 g.p.m. This is made possible by the extensive use of air-fin cooling equipment which saves about 305 g.p.m. of cooling-tower-water makeup. Three water wells located on the plant site provide the water requirements.

Makeup water for the cooling towers is not treated, but control of scaling and dissolved solids is obtained by addition of sulfuric acid and blowdown. Water for domestic use and the boiler feedwater evaporator is Zeolite treated.

Controls . . . Convenience of operation is obtained by grouping control and recording instruments for each system, such as gas treating, compression and gasoline plant in a control room adjacent to operations. Flow and temperature controllers and recorders employ pneumatic transmission.

Extensive safety controls and alarms are used. The compressor suction scrubbers are equipped with high-liquid-level alarms and compressor-engine shutdown equipment. The boilers, besides being equipped with high and low-water-level alarms, have a fuel shutoff for low water level and low fuel pressure. The boiler feed pumps are equipped with low-discharge-pressure alarms.

The oil furnace is equipped with shutdown devices operated by high stack temperature and low pressure drop across the furnace. The plant is also equipped with manual safety devices for bypassing the inlet gas to the plant residue line and to vent the plant gas system. The manual plant shutdown also shuts off the fuel to the oil furnace, boilers, vaporizers, and compressor engines and also turns off the electric power.

Electric power . . . Electric motors are used for motivation on all rotating equipment except the amine and boiler feed pumps, which are steam-turbine driven and the lean-oil pumps which are gas-engine driven. Electric power is purchased.

Other facilities provided at the plant site are a laboratory, warehouses for pipeline maintenance, field meter maintenance and plant maintenance, district office, and a 13-house camp for employes.

Design and construction started in June 1953 by Dresser Engineering Co. The gas-treating, dehydration, and compression facilities were placed in operation December 1953, and the gasoline plant placed in operation in July 1954. Facilities for increasing the gas-processing capacity to 170 M.M.c.f.d. were placed in operation October 1954.

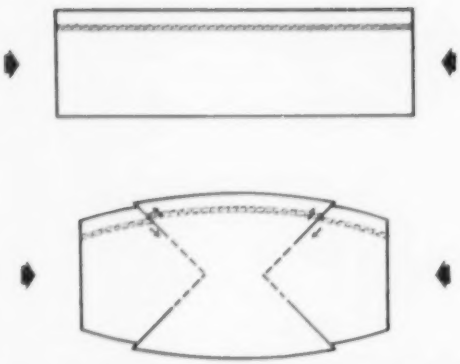
THE AUTHORS

McLAUGHLIN

RICHERT

R. B. McLaughlin is process engineer, Northern Natural Gas Co., Omaha. He has been associated with the natural-gas and natural-gasoline industries for over 30 years.

A. B. Richert has been associated with Dresser Engineering Co. since 1947 and is chief process engineer for that company. He had previously been associated with Phillips Petroleum Co. at Oklahoma City, at Borger, Tex., and with the U. S. Navy.



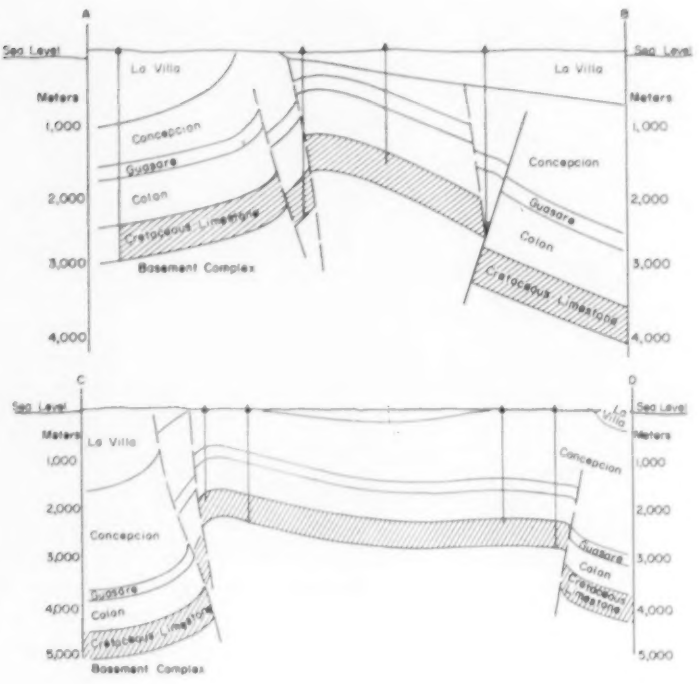


Fig. 1—Horizontal compression may develop a fault pattern similar to the one above (Fig. 1A). This means that several oil traps may develop on a compressed fold as seen at right (Fig. 1B).

A geological study shows that reverse faults due to horizontal compression can occur in opposite directions; the fault planes will converge. This means . . .

Tight Folds Should Harbor More Than One Oil Trap

by Norman S. Morrisey* and Jack L. Walper†

SEVERAL fault blocks can develop on a fold formed by horizontal compression under favorable conditions; oil may occur in any or all of these fault blocks. This conclusion is based on the theoretical fault patterns developed by simple horizontal compression under ideal conditions (Fig. 1A). Such a conclusion is also supported by a study of laboratory models and by a study of certain known oil fields.

This approach explains why reverse or thrust faults can develop from opposite directions; the fault planes normally converge or dip toward each other.

The application of the principles outlined today is not new. Undoubtedly many petroleum geologists have used this type of solution to explain anomalous thrust conditions.

Reverse faulting . . . Compression-type structures are an important source of oil.

Usually the geologist thinks of an anticline formed by compression as similar to Fig. 2. The structure developed from a simple fold; finally a thrust fault occurred. Oil in such structures is usually found in elongate asymmetrical anticlines on the crest of the fold. Occasionally production has been found below the main thrust fault.

Turner Valley in the Alberta foothills is one of the most familiar compressed or thrust anticlines to petroleum geologists. It has produced over 106 million barrels of oil since its discovery in 1915.

However, it is now known that oil also occurs within structures that are related to reverse faults that are also formed by compressive forces; the dip of the fault plane may range from 45° to 90°. By definition, the plane of a thrust fault has a dip of less than 45°.

Mechanics . . . In mechanics, there are three main types of columns that are considered when discussing compression and failure of a column under a load:

1. The short column, where the ratio of length to width is less than 15:1 and usually less than 5:1 (slenderness ratio* less than 40:1).

2. The column of medium length, where the ratio of length to width ranges from about 10:1 to 40:1 (slenderness ratio between 40:1 and 120:1).

3. The slender column or long column where the ratio of length to width is greater than 40:1 (slenderness ratio exceeds 120:1).

The short column fails under a compressive load by shearing if the material is brittle; it fails by yielding or plastic flow if the material is ductile.

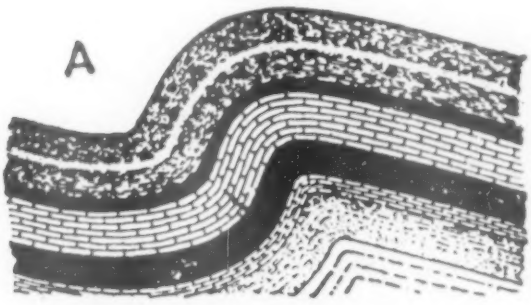
Columns of medium length fail under a compressive load by both shearing and bending.

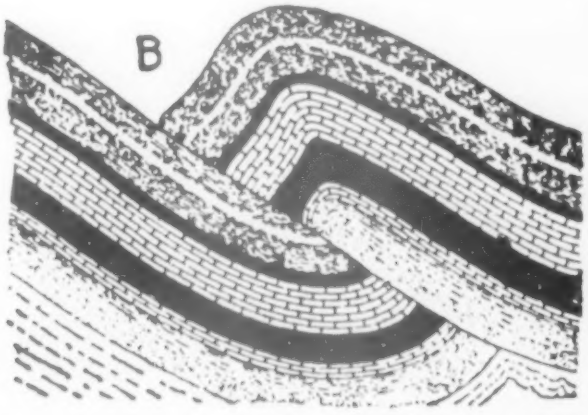
Slender columns are very unstable

*Drilling-development editor, The Oil and Gas Journal, and †associate professor of geology, University of Tulsa.

*Slenderness ratio is the ratio of the length (l) to the radius of gyration (r) and equals l/r.

Fig. 2—The typical thrust anticline apparently develops from a simple fold. The oil and gas usually occur above the main thrust on the crest of an elongate asymmetrical anticline.





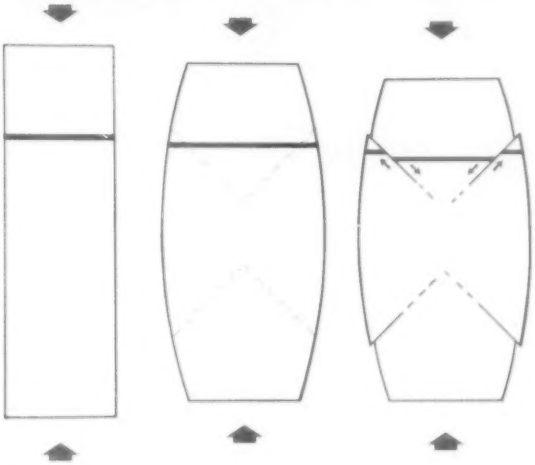


Fig. 3—Under ideal conditions, the short column will develop a set of shear planes as shown when failure occurs under vertical compression.

and will fail under a compressive load by bending alone.

This discussion treats only the short column of homogeneous material in which failure under a compressive load occurs by diagonal shearing.

Failure by plastic flow or yielding, although important, will not be covered.

Laboratory tests . . . Engineers test concrete blocks and other material in compression by placing them in a testing machine. A compressive force is applied perpendicular to the ends of the block until the block fails. After failure, the block may show a set of shear planes or faults similar to those shown in Fig. 3. Only one shear plane may develop; a pair may develop as shown; or several sets of planes parallel to the ones shown may develop. For illustrative purposes, it is considered that one set of shear planes will develop.

Marks are sketched on the figure to show the relative movement of the various wedges. Wedges B and C have moved up with respect to wedge A in the upper half of the sketch; wedge A, then, forms a graben between the two side wedges.

Deep-seated salt domes may have a similar force distribution; i.e., the force of the salt acting upward and the weight of the sediments acting downward. Relief will probably be in an upward direction, but a graben should exist over the crest of a great many deep-seated salt domes and salt ridges.

W. E. Wallace, Jr., ably demonstrated the presence of the graben over such a deep-seated salt feature in his article entitled "Structure of South Louisiana Deep-Seated Salt Domes" (A.A.P.G. Bulletin, September 1944, p. 1249).

Horizontal compression . . . The effect of simple horizontal compression on a short column is shown in Fig. 1-A. It is assumed that the plug or concrete block is homogeneous; that the forces of gravity are insignificant, and that failure occurs by shearing.

After failure under ideal conditions, a set of shear planes may develop similar to those shown. A horst has been

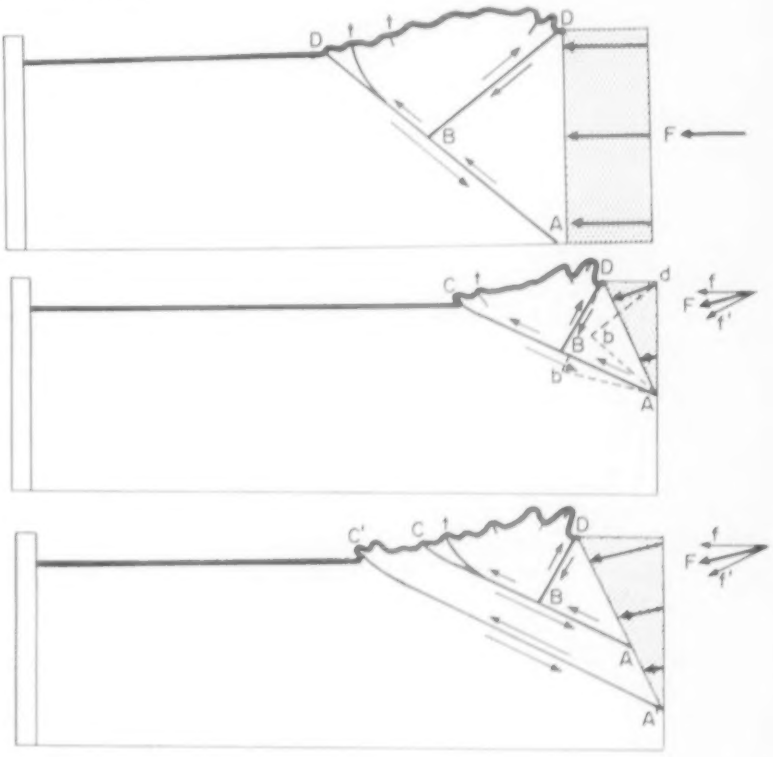


Fig. 4—Hypothetical models show thrusting in two directions with the fault planes converging (after Link, 1928). Compressive force (F) resulted in thrusting in two directions. Condition at top is the result of horizontal compression; center and bottom sketches show the fault patterns developed by rotational stresses.

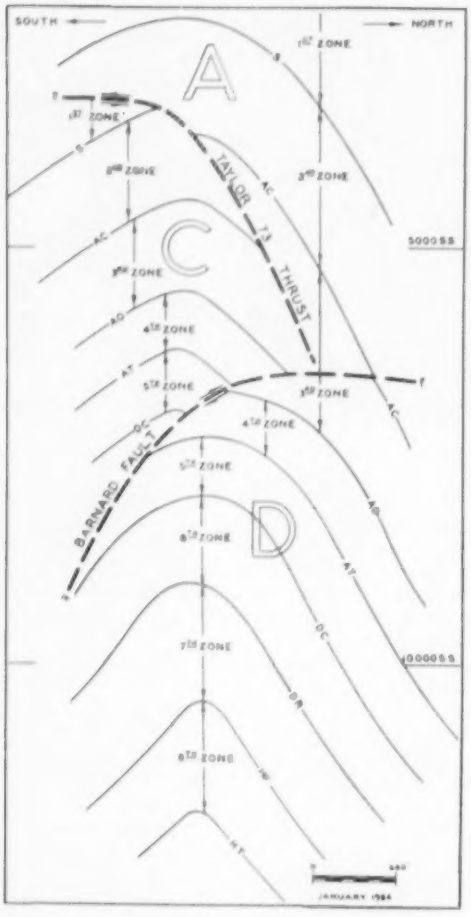


Fig. 5—Thrusting occurs in two directions at the Ventura Avenue field, California.

formed by the relative movements of the various wedges in the upper half of the block. (Link* in 1928 termed the upthrust block a wedge rather than a horst.)

Link recognized the importance of this type of thrusting, terming it underthrusting. In his work, he discovered that underthrusting in the laboratory occurred about half as often as overthrusting (see Fig. 4). On this basis it would appear that this type of faulting should be more common than it is at present.

The most favorable conditions for this type of faulting apparently exist in folded areas where some positive feature acts as a buttress and resists the horizontal compressive force with an equal and opposite force.

Producing Fields

California has many oil fields where thrusting or reverse faulting is an important factor. Fig. 5 is a north-south cross-section of Ventura Avenue field. The Taylor thrust plane dips to the north, whereas the Barnard fault plane dips to the south.

Eola field in Garvin County, Oklahoma, is a complicated structure. More than 50 wells have been completed in this field to date; only a few have failed to cut at least one fault before reaching total depth. Even with over 50 wells, several structural interpretations can be advanced to explain the structure at Eola, and each has its merits.

Basically, however, Eola was a fairly simple structure during Pennsylvanian time, according to the interpretation shown on Fig. 6. The field has a steeply dipping southwest flank with beds inclined at 45° to over 70°. The central part of the field consists essentially of a horst or ramp of northeast dipping beds. The horst is separated from the southwest flank by a complicated reverse fault zone. An overturned, reverse, or thrust fault with 800-1,400 ft. of throw defines the north side of the horst. The presence of this fault was postulated originally on the basis of reservoir performance. The reverse character of the fault was confirmed by wells that repeated sections due to faulting.

Different oil-water contacts in the so-called Basal Bromide sand prove the existence of the various fault blocks.

Subsequent faulting has obscured the relatively simple character of the original structure, making interpretations of the field exceedingly difficult.

*Link, Theodore A., "Relationship Between Over and Under-Thrusting as Revealed by Experiments" Bulletin, A.A.P.G., August 1928, p. 825.

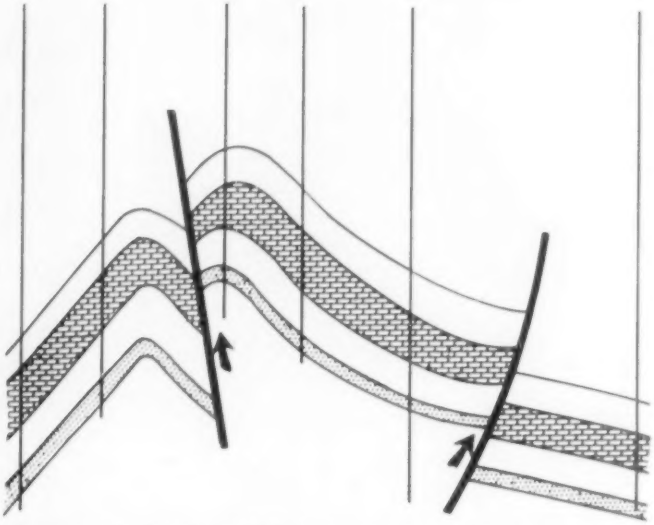


Fig. 6—A restored and simplified cross-section through Eola pool shows that the field has a fairly simple basic structure. Later faulting, however, masks this simple fault pattern.

Application to Oil Finding

Reviews of developed fields are often useful if the principles involved can be used in finding new oil. The same statement applies to theories on faulting. In short, can this approach to faulting aid the geologist? Does it have an economic application?

If the theory is applied with considerable discretion, the answer is "yes, it can be a very useful guide in exploration work." The following examples illustrate how the approach can be used in oil finding. The basic data were obtained from Theodore A. Link's article, "Interpretations of Foothills Structures, Alberta, Canada" (A.A.P.G. Bulletin, September 1949, p. 1475).

Although these examples are in the Canadian foothills belt, similar structures may exist in the Rocky Mountains, in southern Oklahoma, or possibly even along the west side of the Central Basin platform of West Texas.

Such structures can occur in any geologic province where horizontal compression is important.

Foothills fold . . . The first example is a foothills fold that was mapped using surface geology; Fig. 7 shows a cross-section through the anticline. This interpretation is based upon surface geology only; additional well data prove that this interpretation is incorrect.

On the surface beds, the anticline has at least 5,000 ft. of relief; and, on the Mississippian limestone, the potential pay horizon, about 3,500 ft. of relief is postulated. The west flank of the structure is slightly steeper than the east flank; the shallow well on the left had confirmed the steep dip on the west flank. The proposed location was staked east of the surface crest, in the

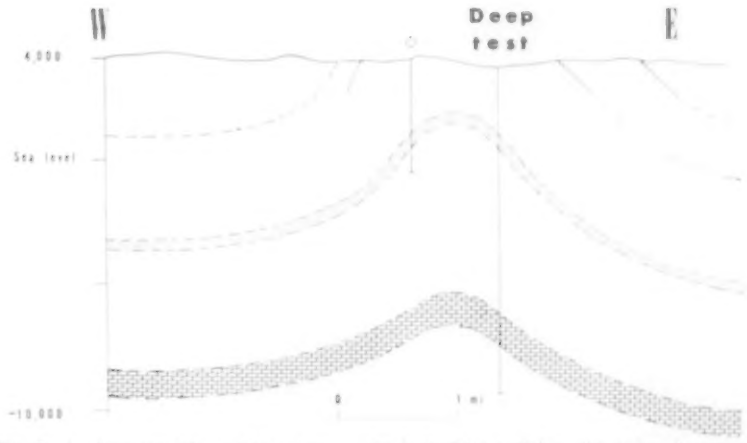


Fig. 7—An incorrect interpretation shows a simple foothills anticline; this is based upon surface geology only (adapted from Link's original data, A.A.P.G. Bull., Sept. 1949, p. 1475).

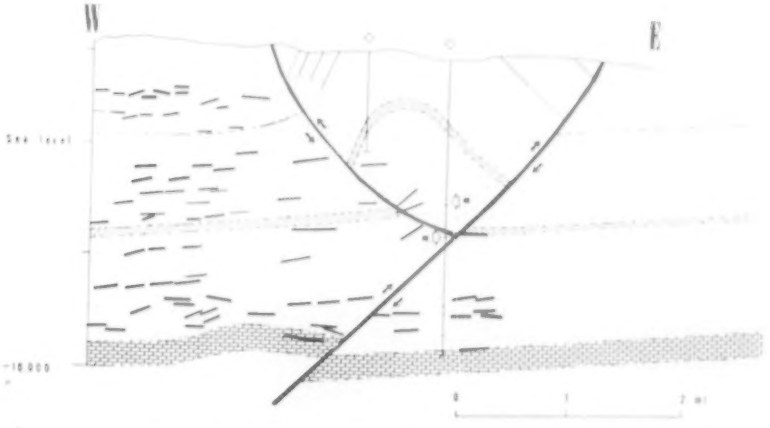


Fig. 8—A better interpretation of the foothills structure results when both geological data are considered (adapted from Link, 1949).

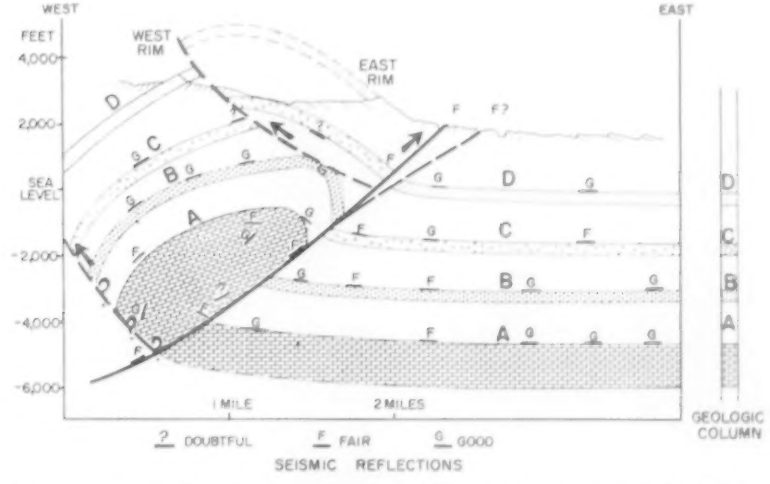


Fig. 9—At least two oil traps may exist on the Alpha structure: in the crest of the deep anticline, and below the main thrust fault. A third trap (not shown) may occur below the inferred reverse fault on the west side of the structure (adapted from Link, 1949).

event that the structure proved to be asymmetrical with depth. The pay zone is expected at a drilling depth of 10,000 ft., or about 6,000 ft. subsea.

A deep test at the proposed location, apparently drilled prior to the shooting of the seismic line shown on Fig. 7, entered the Paleozoic limestone at about 9,000 ft. subsea—almost 3,000 ft. lower than forecast.

What happened?

The seismic section (Fig. 8) helps to answer the question. The seismic reflections below the deep-well site are nearly flat between 7,000 and 10,000 ft. subsea; there is no indication of structure at this level.

The relatively flat reflections between the surface and 5,000 ft. subsea terminate abruptly in the center of the cross-section; cessation of seismic energy in this fashion often indicates a fault. In addition, some of these flat reflections occur directly below steeply dipping outcrops.

A bettter picture results when an eastward dipping reverse fault separates the steep surface dip from the underlying flatter beds. The deep test probably cut this fault, because bed "a" was repeated. The well probably cut another fault to account for the displacement of the Mississippian limestone and the abnormally long section between "a" and the Mississippian. The seismic data indicate that this fault may exist.

The surface anticline was not mapped by the seismic survey, but this is understandable in view of the steep dip.

"Alpha" structure . . . Seismic data and surface geology of the Alpha structure are shown in cross-section on Fig. 9. Alpha structure is a foothills fold; the west flank is slightly steeper than the east flank; there is minor faulting on the crest of the structure and two faults or a fault zone on the east flank.

Several interpretations of Alpha structure can be made using these data, but the authors prefer the one shown (Fig. 9).

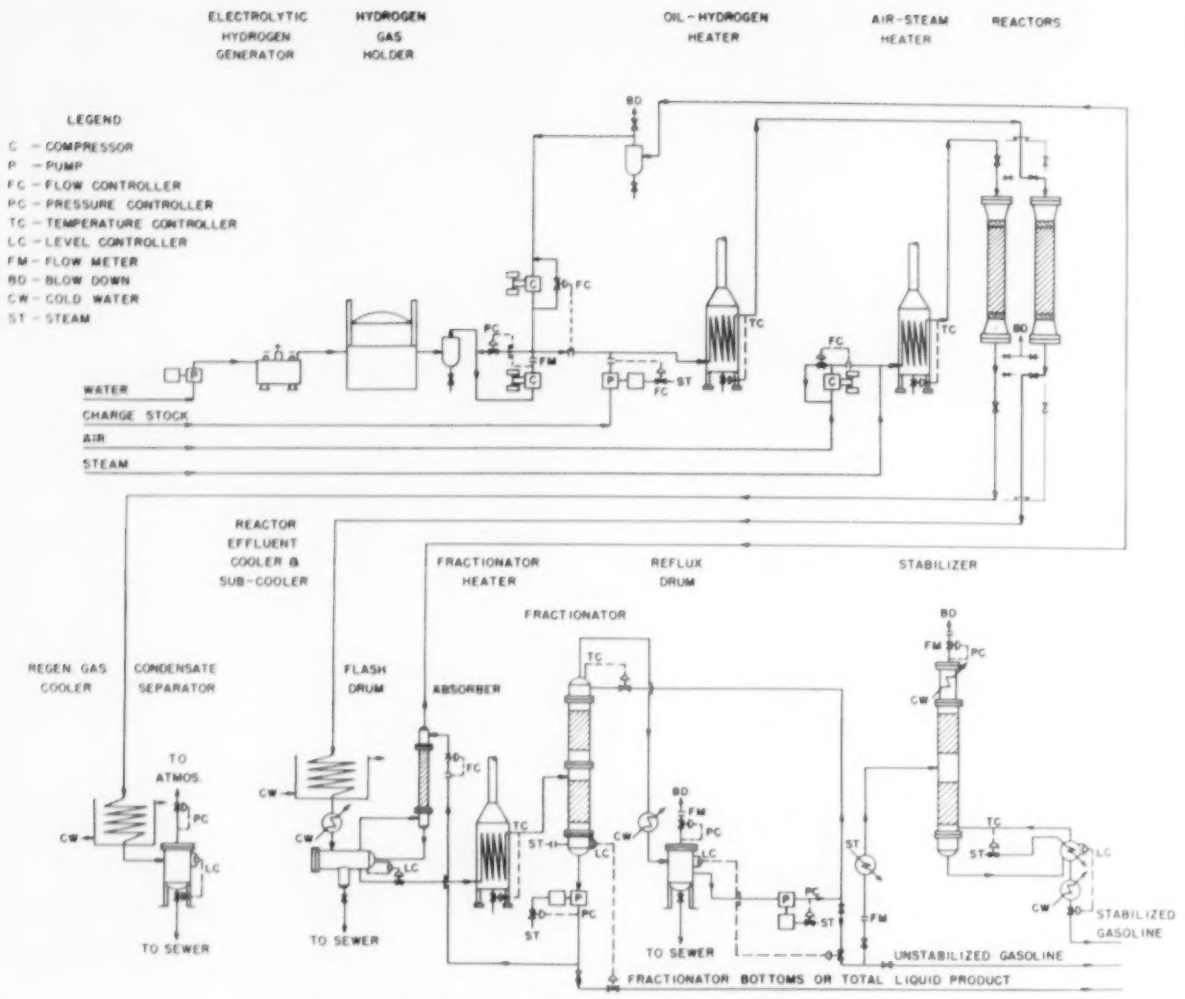
The presence of a reverse fault on the west flank is strongly indicated, based upon the steep dips of 45°-65° at depth on the west flank of the structure.

Two, and possibly three, plays exist on Alpha structure: (1) in the horst, (2) in the frontal trap below the main thrust, and (3) in the possible closure (not shown) against and below the inferred reverse fault on the west side of the anticline.

Conclusions

Thus, it may be profitable to reexamine certain known structures on the possibility that they might be compression-type structures. Such features may offer at least three possible oil traps, any one of which might be productive.

The authors want to stress, however, that this approach cannot serve as a universal rule, applicable to any or all compressed structures. Each anticline must be examined separately; and the geologist must consider all data before he can correctly interpret the structure.



Flow diagram of Gulf's 50-bbl. per day HDS pilot plant. Fig. 1.

The Gulf HDS process for

UPGRADING CRUDES AND RESIDUES

By Jerry McAfee,* C. W. Montgomery,* C. R. Summers, Jr.,† J. H. Hirsch,* and W. A. Horne*

THE Gulf HDS process is a moderate-pressure process which converts heavy residual fractions to lower-boiling distillate products while simultaneously effecting substantial desulfurization of all fractions of the charge stock.

The process involves the use of a rugged compound-supported-metallic catalyst which maintains good activity even after repeated regeneration and in spite of the deposition of considerable amounts of metallic contaminants.

*Gulf Research & Development Co., Pittsburgh. †Gulf Oil Corp., Philadelphia. Paper presented at A.P.I. Division of Refining meeting, St. Louis, May 11, 1955.

During the development of the process in laboratory and 50-bbl. per day pilot-plant operations, a variety of charge stocks have been investigated. These include high-sulfur low-gravity crude oils, topped and reduced crudes, and blends of reduced crudes with high-sulfur distillate stocks.

Along with this experimental work, cost studies of the process reveal that the credits realized from applying the Gulf HDS process to certain crude oils and residues are large and, under appropriate circumstances, justify the big investment involved.

The pilot plant, which was built at Gulf Oil Corp.'s Port Arthur refinery, was operated continuously for over 5 years. During this time the process was proved to be completely feasible from an engineering and operating standpoint.

Simultaneously the data from laboratory units, including a plant with a capacity of approximately 0.5 bbl. per day, which was built for charge-stock evaluations and additional development studies, were correlated with those from the pilot plant.

A simplified flow diagram of the 50-bbl. per day pilot plant is shown in Fig. 1. Hydrogen is prepared in an

electrolytic generator. A compressor takes suction on a gas holder and pumps hydrogen to the reactor system as required to maintain a constant reaction pressure.

The charge stock is pumped from storage to a heater. The oil and hydrogen are heated to reaction temperature either separately or together.

The preheated oil-hydrogen stream enters one of the two reactors. The reactors are so manifolded that one can be used for processing while the other is undergoing regeneration.

The reactor effluent passes through a submerged cooler, a double-pipe subcooler, and a high-pressure flash drum in which gas, oil, and water are separated. The flashed gas passes to an absorber designed to scrub the heavier components from the recycle gas. A single-stage recycle compressor circulates a predetermined amount of the hydrogen-rich gas back to the inlet of the preheating furnace.

The hydrogen content of the recycle gas is controlled by the flow of lean oil to the absorber or by the bleeding off of a portion of the recycle gas from the system.

The hydrocarbon phase, which is mixed with rich absorption oil when the absorber is being used, is withdrawn by a level-control valve to the fractionator.

A portion of the bottoms product is pumped to the absorber, and the overhead product is pumped to a stabilizer. The stabilized gasoline bottoms product flows to storage.

During the processing period sulfur and coke are deposited on the catalyst so that regeneration is required periodically. To remove this deposit, air diluted with either live steam or a recirculated stream of flue gas is preheated to a temperature of 750° to 850° F. in a cylindrical radiant furnace containing Croloy 9 tubes and is passed through the reactor being regenerated.

The regeneration gases are cooled in a submerged coil cooler and pass through a condensate separator. The noncondensable gas is vented to the atmosphere when regenerating with steam or is partly recirculated by the

TABLE 1—TYPICAL RESULTS OF HDS PROCESSING OF WEST TEXAS CRUDE OIL

Yields, wt. % on chg.:		
Dry gas		2.78
Depropanized product		94.51
Catalyst carbon		1.67
Sulfur removed		1.33
Total		100.29
Hydrogen used, std. cu. per bbl. of chg.		426
Charge and product:	Crude charge	HDS product
Yield, vol. %		99.8
Desulfurization, %		85.1
Inspections:		
Gravity, °A.P.I.	34.4	43.4
Sulfur, %	1.48	0.22
Carbon residue, %	2.45	0.06
Charge and product fractions:		
C_4 and lighter, vol. %	1.1	3.2
Debutanized, 300° F. e.p. gaso.:		
Yield, vol. %	19.3	29.4
Inspections:		
Gravity, °A.P.I.	62.4	63.7
Sulfur, %	0.15	0.055
A.S.T.M. motor octane No., clear	55.3	62.7
Naphtha (300° to 410° F.):		
Yield, vol. %	11.6	15.9
Inspections:		
Gravity, °A.P.I.	47.7	46.4
Sulfur, %	0.40	0.03
A.S.T.M. motor octane No., clear	37.2	46.6
Furnace oil (410° to 670° F.):		
Yield, vol. %	27.3	35.6
Inspections:		
Gravity, °A.P.I.	35.6	33.4
Sulfur, %	0.83	0.23
Bottoms (670° and heavier):		
Yield, vol. %	40.7	15.9
Inspections:		
Gravity, °A.P.I.	19.4	21.1
Sulfur, %	1.54	0.39
Carbon residue, %	6.3	1.35

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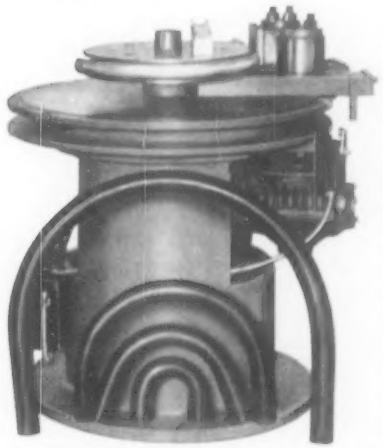

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flue-gas recycle compressor when regenerating with flue gas.

Reactor Operation

The operating procedure for a typical cycle of the fixed-bed downflow version of the process (which has been studied most extensively) is presented as illustrative of normal operation. The oil-hydrogen stream, preheated to the desired reaction temperature, is cut into one of the reactors, and the process flow continues uninterrupted during the desired process period.

At the end of the process period the oil flow is stopped and hydrogen circulation is continued to purge the reactor. During this hydrogen-purge period, usually lasting from 1 to 2 hours, a considerable portion of the oily carbonaceous deposit is removed from the catalyst by hydrogenation. At the end of this period the hydrogen-recycle stream is switched into the other reactor which, by then, has been regenerated.

The first reactor is depressured into the blowdown system and is purged for 10 minutes with superheated steam. The reactor effluent is then cut into the regeneration-gas cooler, and air is added to the regeneration steam or recirculated flue gas as rapidly as is possible without exceeding a catalyst temperature of 1,200° F. The use of steam as the regeneration diluent has been found to be more convenient.

The air-to-steam ratio is maintained as high as consistent with the avoidance of localized overheating of the catalyst bed and reactor. While holding a constant reactor inlet temperature of 750° to 850° F., and a constant steam rate and air-to-steam ratio, the regeneration is continued until the temperature at the outlet of the bed declines to 1,050° or 1,100° F.

At this time the regeneration air flow is stopped, and the regeneration steam is allowed to continue flowing for an additional 5 minutes to purge the reactor. The regeneration steam is then bypassed around the reactor, and the reactor is blocked off until the processing period on the other reactor has been completed.

Just before switching, the reactor is brought to operating pressure by means of recycle gas. The recycle stream is then cut through the catalyst bed, and immediately thereafter oil flow is resumed, thus completing the cycle.

Typical Results

As an example of the results which can be expected when whole crude oils are being processed, Table 1 presents data obtained during a typical pilot-plant run when charging West Texas crude, and Table 2 presents corresponding results from Kuwait crude. Inspection of the data shown in Tables 1 and 2 indicates that the most striking change in product distribution is the pronounced decrease in the amount of the bottoms fraction.

For example, for Kuwait crude the 670° F.+ bottoms fraction has been reduced from 49.4 per cent by volume of the crude to 20.4 per cent by volume of the product, with a corresponding increase in the yield of distillates and a significant improvement in the quality of the bottoms fraction. The octane numbers of the gasolines and naphthas have been increased, but not sufficiently to eliminate the need for catalytic reforming.

The sulfur content of all fractions has been considerably reduced, the overall reduction being in the range of 80 to 85 per cent. In addition, it will be noted that the carbon residue of the 670° F.+ bottoms from HDS processing is of the order of 1 per cent; thus, this fraction may be charged directly to a catalytic-cracking unit.

Table 3 presents data from the processing of Kuwait vacuum-tower bottoms and a blend of these bottoms with a high-sulfur catalytic furnace oil distillate in proportions which roughly correspond to a No. 6 fuel oil. Results are given for operation at two severities on

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each charge stock. In the more severe operations presented in Table 3, more than 90 per cent of the sulfur and carbon residue has been eliminated from the total liquid product.

Appreciable quantities of all distillate products have been produced at the expense of the residual fractions. In the more severe operations only 3.0 per cent and 4.1 per cent of bottoms above cracking charge stock remain. When charging catalytic furnace-oil distillate with the bottoms, considerable desulfurization of the furnace oil is realized which, in certain circumstances, eliminates the need for separate furnace oil treating operations.

As will be seen from the data given in Tables 1, 2, and 3, catalyst coke deposition is primarily a function of charge stock and operating severity. For mild severities with whole crudes, the coke production will amount to only 0.4 to 0.6 per cent whereas, for very severe operations, as much as 3.0 to 4.0 per cent coke may be laid down. From residual stocks, coke production is somewhat higher, ranging from 2.2 to 6.4 per cent in the cases cited, with 2 to 3 per cent envisioned for commercial operation.

Hydrogen is consumed in the process in several ways: actual incorporation into the product, combination with part of the sulfur to form hydrogen sulfide, reduction of catalyst, and solution in the liquid product. For crude oils the total hydrogen consumed for all purposes amounts to 200 to 500 standard cubic feet per barrel of charge whereas, for residual stocks, it is more likely to be in the range of 400 to 1,200 standard cubic feet per barrel, again depending on the stock and specific operating conditions employed.

TABLE 2—TYPICAL RESULTS OF HDS PROCESSING OF KUWAIT CRUDE OIL

	Crude charge	HDS product
Yields, wt. % on chg.:		
Dry gas		4.65
Depropanized product		89.63
Catalyst carbon		3.29
Sulfur removed		2.15
Total		99.72
Hydrogen used, std. cu. ft. per bbl. of chg.		499
Charge and product:		
Yield, vol. %		96.0
Desulfurization, %		82.5
Inspections:		
Gravity, °A.P.I.	30.8	42.4
Sulfur, %	2.61	0.46
Carbon residue, %	5.3	0.06
Charge and product fractions:		
C_4 and lighter, vol. %	2.4	3.2
Debutanized, 300° F. e.p. gaso.:		
Yield, vol. %	16.4	25.8
Inspections:		
Gravity, °A.P.I.	70.3	68.9
Sulfur, %	0.04	0.03
A.S.T.M. motor octane No., clear	47.2	53.9
Naphtha (300° to 410° F.):		
Yield, vol. %	9.2	14.9
Inspections:		
Gravity, °A.P.I.	50.5	47.8
Sulfur, %	0.16	0.05
A.S.T.M. motor octane No., clear	23.4	39.8
Furnace oil (410° to 670° F.):		
Yield, vol. %	22.6	35.7
Inspections:		
Gravity, °A.P.I.	37.3	34.3
Sulfur, %	1.21	0.47
Bottoms (670° F. and heavier):		
Yield, vol. %	49.4	20.4
Inspections:		
Gravity, °A.P.I.	14.4	20.9
Sulfur, %	4.11	0.84
Carbon residue, %	9.8	0.88

TABLE 3—TYPICAL RESULTS OF HDS PROCESSING OF KUWAIT REDUCED CRUDE OIL AND A BLEND WITH F.C.C. FURNACE OIL DISTILLATE

	100% Kuwait reduced crude oil			71.2% Kuwait reduced crude oil; 28.8% catalytic furnace oil distillate		
		Product			Product	
Yields, wt. % on chg.:	Charge	Severity 1	Severity 2	Charge	Severity 1	Severity 2
Dry gas		1.5	6.4		3.3	5.2
Depropanized liquid product		91.7	82.7		91.9	87.2
Catalyst carbon		2.4	6.4		2.2	3.3
Sulfur removed		3.8	5.1		3.4	4.7
Total		99.4	100.6		100.8	100.4
Hydrogen used, s.c.f./bbl. of charge		650	1,140		745	930
Charge and product:						
Yield, vol. %		101.8	99.3		101.3	100.9
Desulfurization, %		69.9	92.5		68.2	91.8
Inspections:						
Gravity, °A.P.I.	5.8	20.8	33.2	10.7	25.2	32.8
Sulfur, %	5.45	1.64	0.41	4.87	1.55	0.40
Carbon residue, %	19.8	8.43	1.09	15.2	4.56	1.73
Charge and product fractions:						
C_4 and lighter, vol. %		0.5	1.3		1.0	1.6
Debutanized, 300° F. e.p. gaso.:						
Yield, vol. %		6.5	14.9		7.5	16.0
Inspections:						
Gravity, °A.P.I.		62.8	61.6		65.6	60.4
Sulfur, %		0.17	0.1		0.32	0.22
Bromine No.		19.4	4.0		19.8	8.0
A.S.T.M. motor octane No., clear		54.0	50.5		53.4	48.8
Naphtha (300° to 410° F.):						
Yield, vol. %		5.2	11.0		7.9	12.6
Inspections:						
Gravity, °A.P.I.		43.9	44.4		43.1	43.1
Sulfur, %		0.11	0.03		0.15	0.04
Bromine No.		13.0	3.3		12.8	6.0
A.S.T.M. motor octane No., clear		46.4	46.5		56.4	54.0
Furnace oil (410° to 670° F.):						
Yield, vol. %		19.3	41.4	28.8	42.4	46.5
Inspections:						
Gravity, °A.P.I.		30.8	32.3	22.7	28.1	28.7
Sulfur, %		0.54	0.16	2.66	0.96	0.29
Cetane No.		45	44	28	39	36
Cracking stock, 670° F. to		925° F.	950° F.		940° F.	920° F.
Yield, vol. %		21.1	27.3		25.1	20.3
Inspections:						
Gravity, °A.P.I.		21.3	20.8		19.9	17.8
Sulfur, %		0.93	0.42		1.39	0.81
Carbon residue, %		0.21	0.59		0.67	0.78
Bottoms:						
Yield, vol. %	100.0	47.4	4.1	71.2	16.1	3.0
Inspections:						
Gravity, °A.P.I.	5.8	9.6	*2.1	5.8	*2.5	*—3.5
Sulfur, %	5.45	2.40	3.72	5.45	3.2	2.5
Carbon residue, %	19.8	19.4	32.9	19.8	29.4	39.0

*Calculated values.

Operating Conditions

Temperature . . . Temperature as an operating variable has been investigated over the range 700° to 900° F. For most stocks the preferred processing

temperature lies between 800° and 850° F. In this range the effect of temperature is relatively minor, the higher values giving slightly better desulfurization, more hydrocracking, and somewhat greater coke laydown.

The net reaction involved is exothermic, and the temperature rise across the catalyst bed typically varies from 10° to 50° F., depending on the charge stock and other operating conditions. Accordingly, care must be exercised in the selection of the inlet temperature to avoid excessive temperatures in the bed.

Pressure . . . The pressure range which has received the most emphasis during this work is from 500 to 1,000 psig., although both lower and higher pressures have been investigated to some extent. In general, increasing pressure gives improved results from desulfurization, hydrocracking, and coke-laydown standpoints; hence, the optimum processing pressure must necessarily be the result of an economic balance between the cost of the higher-pressure operation and the additional credits to be realized.

Present indications are that pressures below 500 psig. result in too high a coke laydown and too low a severity of operation to be economically attractive, whereas pressures above 1,000 psig. do not offer sufficient additional advantage to justify the higher costs involved.

Space velocity . . . The most effective variable in controlling the severity of the operation is space velocity, which has been studied over the range of 0.25 to 4.0 volumes of oil per hour per volume of catalyst. Typical values for most stocks at severities of interest lie between 0.5 and 2.0 volumes per hour per volume. As space velocity is decreased, the severity of the operation is increased, with the degree of both desulfurization and hydrocracking increasing simultaneously.

Process period . . . Another method for effectively controlling the severity of operation in an existing plant is variation of the length of the process period. During the processing portion of the cycle, a catalyst deposit consisting of sulfur and carbonaceous material is laid down on the catalyst, which results in a gradual but continuous reduction in its activity and, hence, in the quality of the product.

Process periods varying in length from one to several hundred hours have been employed in this program. For crude oils and residues, process periods from 4 to 24 hours in length appear to be optimum, inasmuch as they are long enough to avoid complicated switching mechanisms and excessive depressuring losses, and yet short enough to maintain catalyst activity at a satisfactorily high level.

Recycle-gas rate . . . The rate at which the hydrogen-rich gas is recycled has, in most cases, been held within the range of 2,500 to 10,000 standard cubic feet per barrel of charge. Lower recycle-gas rates result in increased coke deposition and a drastic decrease in the degree to which carbon residue is reduced.

This latter effect is frequently accompanied by a dramatic change in the color of the total liquid product from a clear orange (3 to 4 NPA) to a dark opaque (7+ NPA). Higher recycle-gas rates do not appear to offer sufficiently improved results to justify the higher costs involved.

Metallic contaminants . . . An immediate and pertinent question concerning any process for the handling of crude oils or residues is, of course, the effect of metallic contaminants on the activity and stability of the catalyst. The catalytic material used in the Gulf HDS process has been shown to be insensitive to the effect of metal contamination.

One batch of catalyst was used in the pilot plant for well over a year, during which time many different stocks hav-

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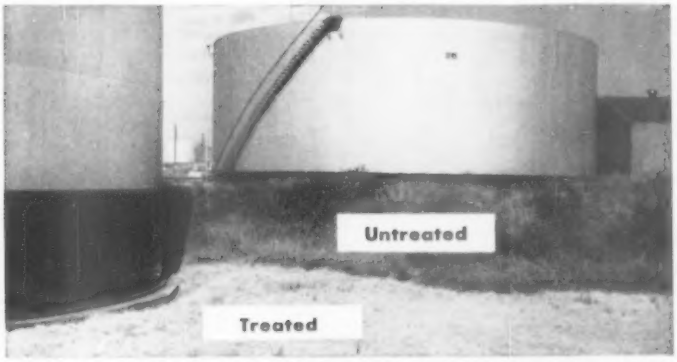

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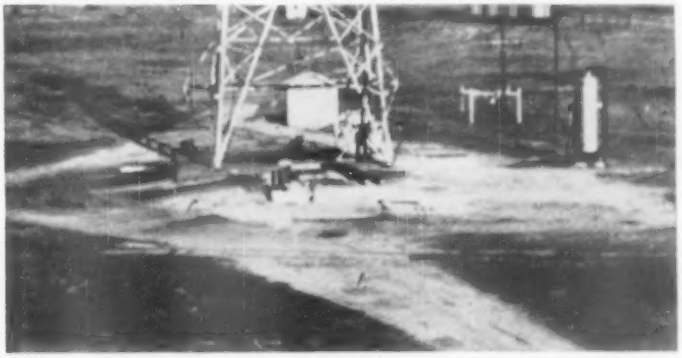

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BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

ing a variety of characteristics and contaminating elements were processed. The activity of the catalyst at the end of this period was only slightly less than at the beginning, although a significant amount of metal contaminants had been deposited on the catalyst.

In an effort to accelerate any possible detrimental effect of metals a high-metals stock containing 453 p.p.m. of vanadium was charged to a sample of catalyst for a series of 69 cycles. During this period 247 volumes of oil were processed per volume of catalyst, and when the experiment was completed, a total of 11.6 per cent of vanadium had been deposited on the catalyst. No significant detrimental effect of the contamination was observed.

Economic Aspects

Numerous studies have been made of the engineering and economic aspects of this process by the various groups concerned within Gulf and by M. W. Kellogg Co., which firm has cooperated in some phases of the latter stages of the development and is handling the licensing of the process.

The most advantageous design for a given application has been found to be dependent upon the type of stock being processed and the severity of the operation. In a situation where there is a relatively slow rate of catalyst deactivation as a result of the deposition of carbonaceous deposits, it is felt that a conventional fixed-bed reaction system is the best design.

The fixed-bed system is particularly suitable for low coke operations as it provides a simple means for conducting the catalyzed reaction between oil and hydrogen; however, it requires relatively costly and complex procedures for catalyst regeneration.

Where rapid catalyst deactivation occurs and frequent regenerations are required, fluidized catalyst systems have been investigated. This type of system would make it possible to operate continuously with a catalyst of constant activity and to regenerate the catalyst easily and efficiently. Problems of catalyst retention make the reaction vessels costly, however, and the control of such a system becomes complicated. Development work is in progress on a design which may make it possible to realize many of the advantages of both the fixed and fluid-bed systems without the corresponding disadvantages.

As a result of this work the conclusion has been reached that several HDS operations are of commercial interest. One of these is the HDS processing of whole West Texas crude, and another is the processing of a blend of high-sulfur catalytic furnace oil distillate and heavy vacuum bottoms from Kuwait crude, as previously described. HDS treatment of whole crude oil is best suited to moderate-size new refineries of 20,000 to 25,000-bbl. per calendar day capacity. For existing refineries, or for larger-size new refineries, the economics appear to favor charging residual fractions or blends of residual fractions with catalytic cycle stock.

As an indication of the process economics, it is estimated that a 20,000-

TABLE 4—CHEMICAL AND UTILITY REQUIREMENTS FOR THE GULF HDS PROCESS

Type of unit—	Fixed-bed‡	Modified fixed-bed§
Chemicals, cents per bbl:		
HDS catalyst	2.8	6.8
Hydrogen prod. catalysts	0.2	0.6
Monoethanolamine	0.5	1.6
Total chemicals	3.5	9.0
Utilities, units per bbl.:		
Fuel gas,* bbl. (F.O.E.†)	0.08	0.13
Power, kw.h.	1.03	0.97
Cooling water, 1,000 gal.	1.46	3.75
Boiler feed water, 1,000 gal.	0.01	0.02
650 lb. steam, 1,000 lb.		0.13
300 lb. steam, 1,000 lb.	0.09	0.18

*Includes process gas for hydrogen manufacture. †F.O.E. = fuel-oil equivalent. ‡West Texas crude oil. §Kuwait Vacuum bottoms-light catalytic furnace oil distillate blend.

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bbl. per calendar day fixed-bed unit for whole West Texas crude oil would require an investment of approximately $500 per barrel of daily capacity, a direct operating cost of 25 cents per barrel, and a total operating cost (including 10 per cent depreciation and all fixed charges) of 50 cents per barrel.

Correspondingly, a 20,000-bbl. per calendar day fixed-bed unit to process a 71 to 29 per cent blend of Kuwait vacuum-tower bottoms and light catalytic cycle oil would require an investment of approximately $800 per barrel of daily capacity, and have a direct operating cost of 75 cents per barrel and a total operating cost of $1.10 per barrel. These investment and operating costs include complete facilities for the manufacture of hydrogen. They would, of course, be reduced considerably if byproduct hydrogen were available, as it is today in many cases.

The costs for whole West Texas crude assume a Gulf Coast refinery location, whereas those for the Kuwait blend assume an East Coast location. Summarized chemicals and utilities consumptions are given in Table 4.

The above costs are admittedly sizable, but they are balanced by very sizable credits. These are large enough that, when these units are incorporated in complete refineries, the studies indicate the refineries with the Gulf HDS process would have, even under present circumstances, payouts on investment comparable with those for the best means of conventional processing.

With only a relatively small reduction in the price of No. 6 fuel oil, the economics would markedly favor the HDS operation. The possibility of lower prices for No. 6 fuel oil, together with the increasing availability of low-cost byproduct hydrogen and the rising sulfur content of available crude oils, seems to indicate clearly that this process will shortly have an important place in refining operations.

Other Hydrogenation Articles

F. W. B. Porter, "The Autofining Process," Proc. A.P.I. 33 (III) 58 (1953).

H. Hoog, H. G. Klinkert, and A. Schaafsma, "Shell Hydrodesulfurization Process," Proc. A.P.I. 33 (III) 71 (1953).

A. C. Patterson and M. C. K. Jones, "Hydrofining's Use in Product Improvement," The Oil and Gas Journal, 53 (24) 92 (1954).

H. W. Grote, C. H. Watkins, H. F. Poll, and G. W. Hendricks, "Unifining . . . A New Petroleum Process," The Oil and Gas Journal, 52 (50) 211 (1954).

George Weber, "Hydrogenation Success Assured," The Oil and Gas Journal, 53 (1) 62 (1954).

Correction

Author R. E. Kelley informs us that the manscript he sent us for his article, "Perforated Plates versus Bubble Caps in Absorber Service," April 18, 1955, issue, page 128, contained two errors. The top line, middle column, page 130, should state that pressure drop is proportional to the square of the vapor velocity, rather than proportional to the vapor velocity. The last reference to the paper should have listed F. A Zenz as the author.

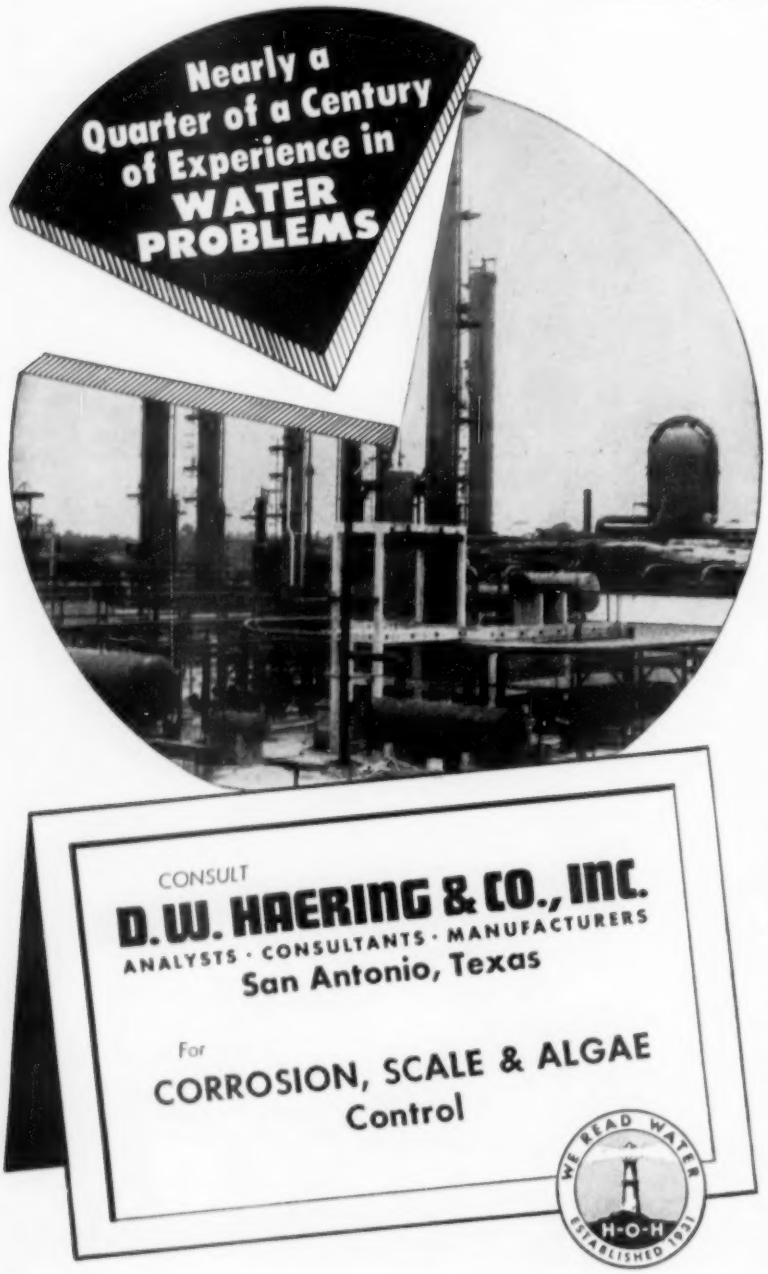
BOOKS

DRILLERS HANDBOOK ON ROCK. Published by Davey Compressor Co. Available from Rock Drilling Division, Davey Compressor Co., Kent, Ohio. 58 pp. $1.50.

This pocket-size booklet contains a complete description of all common rocks. It discusses their hardness, texture, fracture, and formation in detail. Readers are instructed on how to judge the speeds with which various rocks can be drilled. The handbook contains 71 illustrations and 15 charts, as well as a glossary of about 150 commonly used rock and mineral technical names and terms.

IRA RINEHART'S YEARBOOK 1955. A statistical and graphical summary of 1954 well information, compiled and edited by the staff of Rinehart Oil News Co.'s Special Publications Dept. Box 1208, Dallas.

The book is in two volumes. The first volume covers developments and statistics of Oklahoma, Kansas, Texas, and the Hugoton embayment area. Volume two covers the southeastern states and the Rocky Mountains. Each volume is well illustrated with graphs, and geologic sections, and contains a wealth of statistical information.



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Two pumps make a good dual producer

by Ed McGhee
District Editor

ARGO OIL CORP. has installed two separate pumping units on its dually completed 2 Beck in Prentice field, Terry County, Texas. The well is fitted with two independent tubing strings, but both are anchored so that no "breathing" will be caused by the reciprocating motion of the sucker rods. This installation has the advantage of simplicity. Either rod string can be pulled independently of the other. During service work, the two producing zones are not commingled. Moreover, the two tubing strings give a positive check on the production of each zone.

Glorieta and Clearfork . . . Argo's well is completed in the Glorieta from 5,891 to 6,012 ft., and in the Clearfork from 6,583 to 8,847 ft. Casing in the well is 7-in. o.d. to 6,037 ft., with a 5-in. liner to total depth of 6,933 ft. There is a retainer-type packer in the liner at 6,557 ft.

When the well was dually completed, a string of 2⅜-in. E.U.E. tubing was run in and latched into the retainer packer. About 10,000-lb. strain was taken on this tubing when it was landed in the O.C.T. tubing head. In this string, a special tool was run at 5,947 ft.

The next step was to run a string of 2⅜-in. integral-joint tubing with a latching sub on the bottom. This latching sub engages the special tool in the first string. About 4,000-lb. strain was taken on this second string when it was landed in the tubing head.

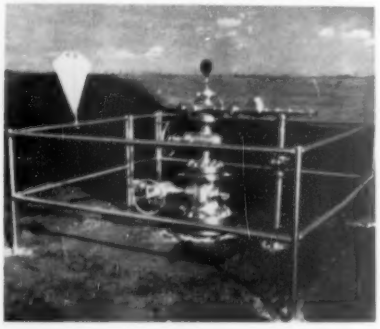
It is this strain taken on the tubing strings that prevents them from working and wearing excessively when the well is pumping. Seating nipples for the Glorietta zone pump is at 5,916 ft. For the Clearfork, the seating nipple is at 6,524 ft.

Meter lock prevents mercury pilfering

IN fields near cities or schools, there is the ever present danger of loosing mercury to pilferers. To prevent this in Fairbanks field of Harris County, Texas, Warren Petroleum Corp. uses a case over the U-tube of the meter. This case is built from scrap tank iron and has a handy lock at the top.

The case is built from a piece of metal which is bent to form an inverted cone with the lower end cut off and welded shut. This shell fits up over the U-tube of the meter. The locking device is made by inserting a bolt through eyes which stick up from the top of the case. The head of the bolt carries an eye which matches a hole in the strap welded to the top of the box.

The meter is not changed in any way. After the assembly is made up in the meter shop, it can be placed on any meter of this make. The meter man has a key which fits all locks placed on the meters.



They can pull these guards any time!

NOT that Superior Oil Co. ever expects to work a well over in the southern Kansas region. But they do fix the guards around the flowing wells so that they can easily be removed by cementing in one socket to hold each corner post and one for the gate post.

The guard rails are made to come apart by removing pins on the two corners in the foreground. This divides the unit into three pieces for easy handling. These can be made up in the shop with the sockets tied onto the posts for delivery to the well site.

Holes are dug at the proper place for the corner and gate posts. The sockets, together with the guard rail, are then set in place and cemented so that there is a perfect fit for easy removal and reassembly.

How to backfill slush pits sooner

IF the contractor waits until the pits are completely dry before trying to backfill them, he will wait a long time.

If he backfills too soon, the water and mud in the pit will eat him up.

G. E. Markel, a dirt contractor from Great Bend, Kans., sends the tractor out when the ground has soaked up the water and mud for a few days. Then he has his operator put the blade of the cat in a tilted and angled position so he pushes the dirt along the long side of the pit.

In this way, the dirt flows into the side of the pit. The track of the tractor works its way over the loose dirt. And in doing so, it compacts the dirt so that the tractor can eventually work its way over the surface of the pit and restore the ground to its original condition.

Where the tractor just pushes the dirt in, it will bog down on the loose dirt which has not been compacted. The lease is operated by National Co-operative Refining Association, just north of Great Bend.

Cooler repairing!

A SIMPLE, cool repair shop was arranged by the "trabadores" of Pemex at Reynosa, Mexico, by putting a roof between two portable tool houses. This required only a few two-by-four timbers and some sheets of corrugated iron.

Besides making a cool place to work, the open ends provide a quick means of moving heavy equipment in and out of the shop. The two tool houses were spotted some 15 ft. apart. Then, after the roof was installed, some planking was put on the ground to hold heavy equipment. The large pulling machines could be run through the building far enough so that the part to be moved could be spotted under a chain hoist which is out of sight on the back of the building.

Handy bins permit fast pipe movement

ON Musgrove Petroleum Corp.'s rig working in Harper County, Kansas, provisions are being made to move the drill pipe in bins which are placed beside the walk and raised into the derrick with the trolley line. When the drill pipe is singled down, each joint is swung into the bins, sucked up onto a pipe truck, and moved without the necessity of rolling pipe.

The first rig was made of standard 4-in. pipe which bent too easily. So the second set shown was made from 4½-in. drill pipe. The short nipples attached to the top rail swing out and lay on the walk or the next bin so the pipe can be handled easier.

As soon as the paint operation is done, the bins will replace the "obso--lete" racks in the background.

Simple heater bypass reduces down time

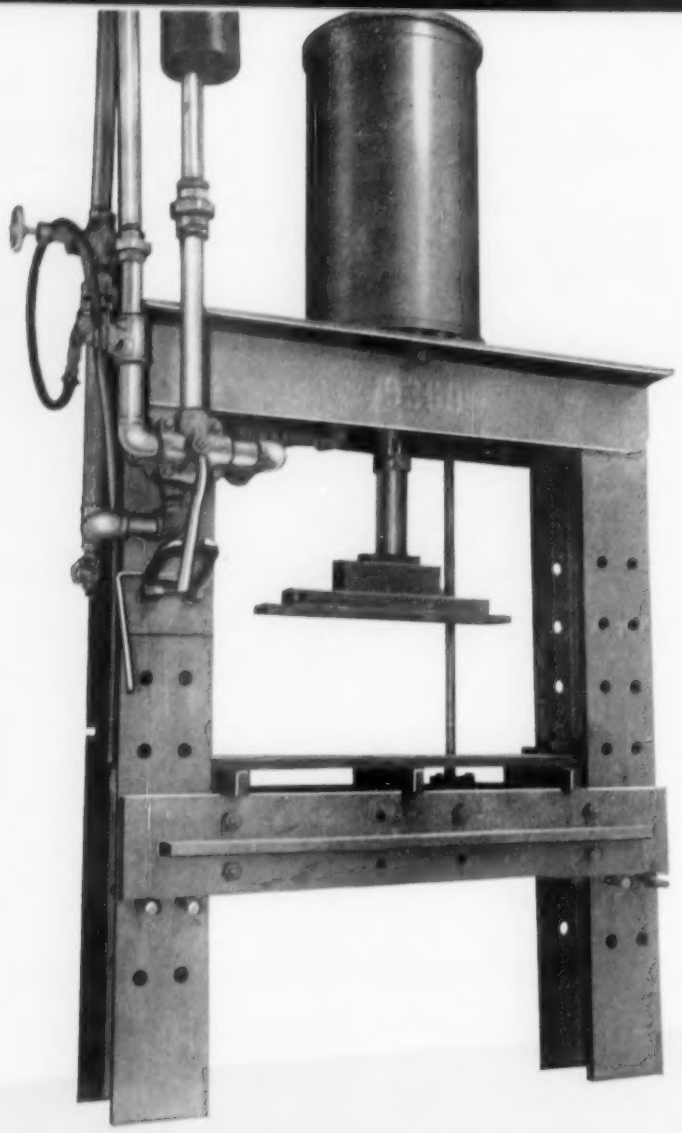
ONE company in Kansas uses a simple bypass on the heater to take it out of service for repairs or when the oil being produced does not need to be treated.

The bypass consists of simply hooking the inlet lines and the outlet lines from the heater-treater across each other and putting a valve between. Since valves are already necessary on the inlet and discharge lines, the nipple and union and valve are all that are required.

In the illustration, the oil enters from the flow line in the ground and passes through the ell and check valve to the tee. Then it flows through the valve into the bottom of the heater-treater where the oil emulsion is separated during the upward movement of the oil, usually through some baffles or "hay."

At the top of the separator, the oil normally comes out to the tanks through the lower connection, unless it is time to top out a tank. Then it is only necessary to close the lower valve to build up enough oil to shorten the topping out time.

If it is desired to bypass the treater when a well that does not make cut oil is being produced, it is necessary only to close the valve on the inlet line near the separator and open the one on the riser. Then the oil will flow directly to the stock tanks.



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Each centralizer spring is carefully formed with a bowed height that is greater than it should be for its length . . . in accordance with Baker's original Optimum Centralizer Spring Design. The spring is then completely flattened by the press and allowed to return to the exact bowed height specified by the Optimum Spring Design.

WHAT THIS MEANS FOR YOU...

You lose practically none of the centering range, reach or performance offered by the centralizer on the way in to the cementing area. We absorb much of the loss in range due to set, that would otherwise be lost during the running of casing.

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And because flattening each spring also tests the spring for cracks or flaws that might result in excessive distortion or fracture you are assured of maximum performance from each spring.

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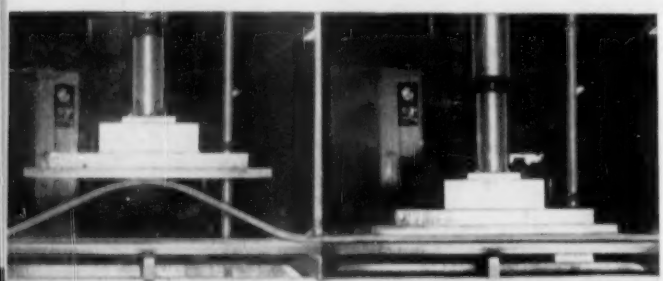
It's what is done with the design—the translation of the design to practical application—that is of paramount importance.

Baker Centralizers are exceptionally well designed . . . but it's the ever continuing checking, testing and skilled manufacturing that provides the dependable and exceptional performance you have come to expect from Baker Products.



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ENGINEERING FUNDAMENTALS

ELECTRIC LOGGING—58

How Laterologs Compare in Effectiveness

by R. I. Martin

THE effects of an invaded zone on the Laterolog will depend on whether its resistivity is very much higher or very much lower than the true resistivity. A low resistivity will not reduce the apparent resistivity greatly, but a high resistivity will have much greater effect and will result in apparent resistivities which may be misleading.

Fig. 1 shows how much better is the response obtained from the Laterolog. Under the conditions selected—thin high-resistivity bed, low mud resistivity—the normals and lateral record extremely low apparent resistivities. In contrast, the Laterolog records approximately 80 per cent of the true resistivity.

Fig. 2 shows for comparison a conventional log taken in mud of high resistivity (1.7 ohm-m at bottom-hole temperature), and Laterologs 3 and 7 taken in salty mud (0.2 ohm-m at bottom-hole temperature). Current beam thicknesses are 6 and 12 in. respectively. Points of interest are:

1. Both Laterologs show more detail than that given by the 16-in. normal. Most of the peaks on the latter are shown to be made up of several layers of sand with thin shale breaks.

2. Laterolog 3 gives a better definition of lithology than Laterolog 7.

3. Laterolog 7 gives higher apparent resistivities in general. Only very thin beds show lower resistivities than they do in Laterolog 3.

Because of detail shown, and better approximation of true resistivity, the Laterolog offers considerable advantages.

Author is assistant professor of petroleum engineering, Missouri School of Mines and Metallurgy.

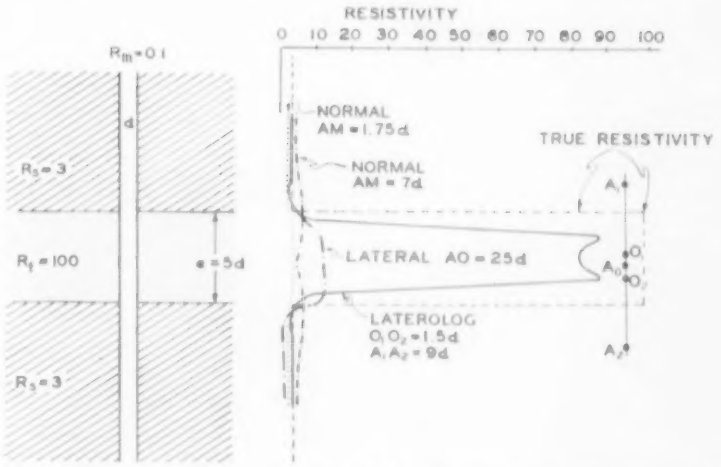

Fig. 1—Response of the Laterolog. The bed is thin and highly resistive. The mud is of low resistivity.

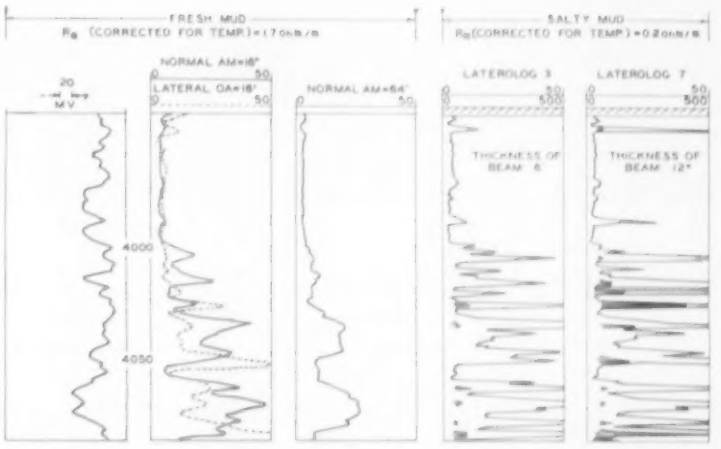

Fig. 2—Field example showing a comparison of conventional electric log with the Laterolog. Both figures from Doll, "The Laterolog," Trans. A.I.M.E., Vol. 192, 1951.

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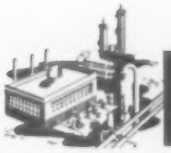

JOB IMPROVEMENT FOR THE PROCESS FOREMAN—4

How We Make Use of Gas Pressure

BECAUSE gases respond so readily to different temperatures and because they are compressible, we can use them to our advantage in the refining industry.

Air is stored in vessels for use in air drills, air hammers, and pumps. Nitrogen, oxygen, and many other gases are refined and stored in drums and later transported in cylinders to consumers. Steam is generated and is held under pressure to be used in steam engines, steam pumps, and steam turbines. Natural gas from producing wells or our high-pressure burner line gas is conveyed from its source to the point of use through pipelines by pressurizing and transporting it under pressure.

To study some of the principles governing the behavior of gases, suppose we use air—the most common gas known. Air is so common that we rarely think of it as being a gas or even as having weight or volume. Yet we know that a vessel or a pipeline cannot be filled with a liquid unless the air is allowed to get out. We can demonstrate that air does have weight by weighing an empty can, then pumping air into it and sealing it. The weight of air makes it rush into every place where room is made. If we expand our chest, air rushes into our lungs. Contract them and the air is forced out—and so we breathe. We do not force air into our lungs. We simply make room and it rushes in.

Q. What's a vacuum and how do we use it?

A. Long ago, it was proven that air could be almost completely withdrawn from a vessel and that a vacuum, or lack of air, remained. It is impossible to pump absolutely all the air out of a container and thus make a perfect vacuum. But enough air can be pumped out to be effective.

At first, vacuum pumps were found only in laboratories. Then it was found that the principle of the vacuum could be used in cleaning. Electric light and x-ray bulbs are made with a partial vacuum which makes them more efficient. A vacuum is maintained on the condensers of our steam engines or turbines in our distillation processes and in our refrigeration processes. A gasoline engine gets its charge by pulling a vacuum on the carburetor, thus filling the cylinders with an explosive mixture of gas and air.

Q. How do vacuum pumps work?

A. The working of a vacuum pump may be explained as follows: When the piston in the cylinder is pulled out, air from the vessel being evacuated rushes in to fill the space made in the pump. When the piston is pushed down, the valve in the pump is closed and the air in the pump cylinder is forced out the exhaust line of the pump. The action is repeated again and again until very little air is left in the vessel and it becomes a partial vacuum.

Since we have found that air has weight and rushes into any available space, we know it exerts pressure. Like water, it exerts as much pressure upward as downward and to all sides, and we do not notice it.

Q. What's atmospheric pressure, and how can we measure it?

A. Experiments have proven that the pressure of the atmosphere at sea level is about 15 psi. The pressure gages commonly used in the refinery are set to read zero pressure even though the atmospheric pressure is actually 15 psi. You can measure atmospheric pressure by filling a glass tube (which is sealed at one end) with mercury. Now with your thumb held over the end of the open tube, invert this tube and place it in a cup of mercury. The mercury will fall in the tube until the pressure of the atmosphere causes it to stand in the tube at a height of about 30-in.

Any liquid could be used to demonstrate the pressure of the atmosphere. But mercury is normally used because its greater density permits use of a shorter tube. The 30-in. height of the mercury can be shown to be equal to about 15 psi.

Q. How can we measure vacuum pressure?

A. Suppose we took the tube of mercury setting in the dish of mercury as we described it above and placed both tube and dish in a container that could be evacuated. Then we could show that, as the atmospheric pressure is reduced, the height of the mercury in the glass tube would fall. And if we could create a perfect vacuum in the container, we would find that the mercury in the tube would fall to the same level as the mercury in the dish. In this way, we could show that a perfect vacuum is equal to about 30 in. of mercury, or about 15 psi. below atmospheric pressure.

Q. What are some practical applications of vacuum?

A. Wind is air in motion, and air is set in motion by creating a vacuum. An electric fan drives the air off the face of its blades and sets up a vacuum at the rear of its blades. Air rushes into the vacuum and the operation is continued.

A blower forces the air off at the tips of its vanes and thus creates a vacuum at its center. This vacuum is so great that solid materials will rush into it. Thus it is made to drive dust, grain, earth, and many other materials some distance away.

Liquid pumps are vacuum pumps in which liquids are allowed to fill the vacuum rather than air. The piston pump, either single or double-action, creates a vacuum by the pull. This vacuum fills with liquid, and the return stroke forces the liquid out a discharge line. Valves operate to hold the pressure in both sections. A centrifugal pump acts the same as a blower. The liquid enters the vacuum at the center of the rotor and is discharged off the tips of the vanes into a line that carries it away. A rotary pump drives the liquid through the case by means of gears. Thus all kinds of suction pumps for gas or liquid are applications of the principle of the vacuum.

This material is taken from training program notes, Esso Standard Oil Co., Baton Rouge, La.; and from notes supplied by refining department, Phillips Petroleum Co., Bartlesville, Okla.

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—Hydraulic boosters provide power steering *and* braking.

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—7-roller track frame improves stability and ride.

—New starting engine has electric starting system and simple single-lever control for easy operation from the seat and insures fast starts in all weather.

All in all, the new D9 sets a new standard of big, money-making, earthmoving performance. Get the full facts about this rugged giant from your Caterpillar Dealer.

FAST FACTS ON THE D9

FIRST TRACK-TYPE TRACTOR WITH TURBOCHARGER! The D9's new Turbocharger is driven by the engine exhaust, utilizing energy which would otherwise be lost. Packs air into engine according to engine *load*, not speed; means more working HP — greater performance.

CHOICE OF TORQUE CONVERTER OR DIRECT DRIVE! Two types of drive are available, the exclusive Caterpillar oil clutch with six-speed (forward and reverse) transmission or a three-stage torque converter with 5:1 torque ratio. The transmission used with the torque converter has three speeds forward, two reverse. This option enables you to match the drive you want to your job requirements.

COMPLETELY NEW 286-HP ENGINE! In addition to the Turbocharger, the powerful new D9 Engine features a 6¼" bore and 8" stroke and runs at 1200 r.p.m. Long life and dependability are promoted by stationary oil jet piston cooling; short, rigid valve push rods give smooth, accurate valve action; "Hi-Electro" hardened gear at rear of crankshaft drives timing gears and accessories; other advanced features.

WIDE RANGE OF OPERATING SPEEDS!

Torque converter: 3 speeds forward, 0 to 4.1 m.p.h., 0 to 5.7 m.p.h., 0 to 7.8 m.p.h. • 2 speeds reverse, 0 to 4.1 m.p.h., 0 to 7.8 m.p.h.

Direct drive: 6 speeds forward, 1.6, 2.1, 2.9, 3.9, 5.0, 6.8 m.p.h. 6 speeds reverse, same

CONSTANT-POWER DRIVE FOR REAR-MOUNTED EQUIPMENT! You always have power for cable controls, direct from the engine's rear power take-off. This makes cable control operation completely independent of flywheel clutch or torque converter, boosts operating efficiency.

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THE D9— NEW KING OF THE CRAWLERS

by W. L. Nelson
Technical Editor

QUESTIONS ON TECHNOLOGY

Prices of Paint and Paint Materials

"On your Cost-imating page, you show costs indexes for prepared paints but no costs are given. What is the actual cost of paint?"—M.K.L.

The prices of paint and related materials have changed as shown in Table 1. The actual wholesale costs of some prepared paints and the materials that are used in their manufacture are shown in Table 2. These were taken from statistics by the Bureau of Labor, U. S. Department of Labor, which are published monthly in "Wholesale Price Index." In addition, an indication of the cost of painting is given in Cost-imating No. 23 of March 24, 1949 (p. 303). The cost of labor is more than double the cost of the paint.

TABLE 1—CHANGES IN THE PRICES OF PAINT (1946 = 100)

	Paint and paint materials Code 6-20	Prepared paint Code 6-21	Paint materials Code 6-22
1926	84.4	96.1	73.2
28	78.5	94.5	64.6
1930	76.4	93.6	61.6
31	67.0	86.1	51.5
32	60.0	78.9	44.8
33	61.8	76.8	49.5
34	67.1	82.5	54.3
35	67.4	82.5	54.7
36	67.6	82.5	55.3
37	70.4	82.4	60.4
38	68.6	89.3	51.5
39	69.8	89.3	53.6
1940	72.4	90.7	56.9
41	77.1	92.3	64.5
42	84.7	95.4	75.6
43	86.4	95.4	78.8
44	88.8	95.4	83.1
45	90.2	95.4	86.0
46	100.0	100.0	100.0
47	140.0	138.9	137.0
48	143.0	141.4	132.2
49	141.2	142.8	118.1
1950	136.9	140.0	107.1
51	153.9	153.8	127.8
52	151.9	155.7	129.7
53	150.9	156.7	124.2
54		159.0	124.3
Dec. 1954		159.1	124.3

Nationally Integrated Gas Pipeline

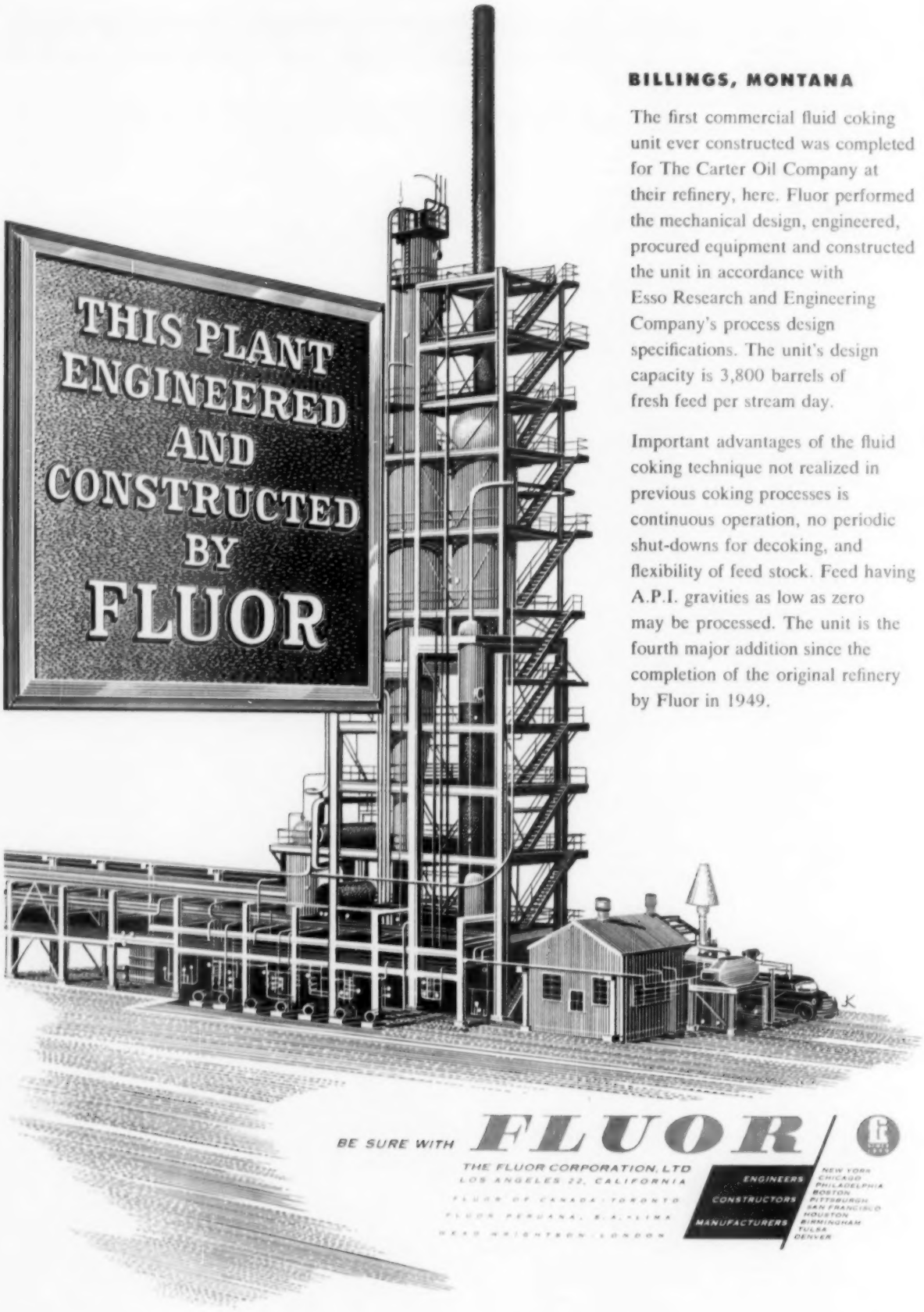
"Would a nationally integrated pipeline system operating at a pressure sufficient for liquefaction of methane or natural gas be feasible? The line itself would act as a storage reservoir and in addition storage spheres could be placed at intervals."—J.G.F.

Although an integrated gas pipeline system that could be drawn upon at any point of need has certain merits, the construction of a high-pressure system would be so expensive that it could not be undertaken. The numerous high-pressure valves required to block off parts of the system for repairs would be almost prohibitive in cost.

Methane (and most natural gases) cannot be liquefied at prevailing atmospheric or ground temperatures, and accordingly the liquefaction of gas at prevailing temperatures cannot be considered. It is barely possible that a pressure system operating at 400-600 psi. and at temperatures of minus 100 to minus 150° F., might be feasible in certain areas. The line would have to be heavily insulated and sealed from moisture. The economics of such a venture would depend mainly on the use of the cold gas as a refrigerant before it was burned as a fuel.

TABLE 2—PRICES OF PAINTS AND PAINT MATERIALS

Code	Description—	Prices 1946	Prices Nov. 1954	Index Nov. 1954
Prepared paints (manufacturer to dealer, delivered, in gallon containers):				159.0
6-21-01	Emulsion, water thinned, inside		$2.372/gal.	
6-21-11	Varnish, floor, first-grade	$2.938/gal.	$3.682/gal.	125.3
6-21-21	Enamel, white, gloss, first-grade	$2.90/gal.	$4.497/gal.	154.9
6-21-31	Inside, flat white, first-grade	$1.702/gal.	$2.868/gal.	168.7
6-21-41	Outside, white, first-grade	$2.510/gal.	$4.342/gal.	173.0
6-21-51	Porch and deck	$2.434/gal.	$3.727/gal.	153.3
6-21-61	Roof and barn	$1.391/gal.	$2.467/gal.	177.3
Paint materials:				124.3
6-22-01	Barytes, Western, domestic, water-ground, paper bags, car lots, ex-warehouse N. Y.	$35.30/ton	$60.10/ton	170.4
6-22-06	Butylacetate, normal, fermentation, drums, car lots, freight allowed east of Mississippi	$0.215/lb.	$0.15/lb.	69.7
6-22-11	Iron oxide, black, magnetic, Type 1, bags, car lots, f.o.b. factory	$0.084/lb.		
6-22-16	Lead, white, basic carbonate, dry, car lots, freight allowed east of Rockies	$0.154/lb.	$0.175/lb.	113.8
6-22-21	Titanium dioxide, anatase, regular, bags, car lots, delivered		$0.225/lb.	
6-22-26	Lithopone, ordinary, bags, delivered	$0.046/lb.	$0.083/lb.	180.5
6-22-36	Oil, linseed, raw, drums, car lots, Zone 3	$0.197/lb.	$0.135/lb.	68.5
6-22-41	Mineral spirits, tank cars, f.o.b. New York		$0.17/gal.	
6-22-46	Rosin, gum, WG grade, f.o.b. Savannah	$7.128/100 lb.	$9.25/100 lb.	129.8
6-22-51	Shellac, orange, T.N., bags, f.o.b. New York	$0.514/lb.	$0.485/lb.	94.4
6-22-56	Turpentine, gum, bulk, f.o.b. Savannah	$0.953/gal.	$0.72/gal.	75.5
6-22-61	Glycerin, dynamite, car lots, drums, delivered	$0.305/lb.		
6-22-66	Zinc oxide, Am. process, 35 per cent leaded, bags, car lots delivered	$0.080/lb.	$0.14/lb.	175.0
6-22-71	Phthalic anhydride, bags, car lots, f.o.b. works	$0.200/lb.		
538	Bone black, powdered, Grade 4, car lots, f.o.b. works	$0.096/lb.		
541	Lampblack, domestic, Type 1, cartons, car lots	$0.085/lb.		
542	Prussian blue, delivered northeastern territory	$0.360/lb.		
543	Green, chrome, 21-25 per cent blue, delivered	$0.275/lb.		
544	Yellow, chrome, delivered northeastern territory	$0.175/lb.		
547	Lead, red, dry, delivered	$0.116/lb.		
549	Litharge, commercial, delivered	$0.105/lb.		
553	Putty, commercial, f.o.b. New York	$0.05/lb.		



BILLINGS, MONTANA

The first commercial fluid coking unit ever constructed was completed for The Carter Oil Company at their refinery, here. Fluor performed the mechanical design, engineered, procured equipment and constructed the unit in accordance with Esso Research and Engineering Company's process design specifications. The unit's design capacity is 3,800 barrels of fresh feed per stream day.

Important advantages of the fluid coking technique not realized in previous coking processes is continuous operation, no periodic shut-downs for decoking, and flexibility of feed stock. Feed having A.P.I. gravities as low as zero may be processed. The unit is the fourth major addition since the completion of the original refinery by Fluor in 1949.

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LUBE-OIL ADDITIVES—4

Increasing the Viscosity Index, Depressing Pour Point

by J. Brent Malin

THERE are certain polymers of high molecular weight which, when added to petroleum oils, improve the viscosity index of the base oil and at the same time have a thickening effect.

One of the earliest (1867) of these materials was India rubber. As might be expected, however, the mixture of rubber and oil is unstable at temperatures which exist in an engine. Consequently, it is unsuitable.

There since have been other compounds developed which show good resistance to the oxidation and shearing stress which occur in normal engine operation. These compounds are generally giant molecules ranging in molecular weight from 5,000 to above 500,000.

The chemical structures of two typical compounds are shown in Fig. 3.

Colloidal suspension? . . . An academic question exists as to whether the molecules, because of their size, exist as a solution of the polymer in oil or as a physical state approaching a colloidal suspension. One general theory on how these polymers improve viscosity index holds that at low temperatures the solubility of the polymer is limited and it behaves as a colloidal suspension. Its long molecules curl up and cause a relatively small increase in the base-oil viscosity. At higher temperatures, solubility is increased and the molecules uncoil, giving a relatively small increase in oil viscosity. Consequently the viscosity of an oil containing a VI improver is less sensitive to temperature changes than the oil without the additive.

In service, when the VI polymers are subjected to high shear rates, the molecules tend to become broken into smaller pieces and thereby become polymers of shorter chain length. These show both reduced thickening power and less VI improvement. This shearing can result is a loss of up to more than 50 per cent of the VI increase imparted by the additive. This depends on the additive type, molecular weight, and service in which the oil is used.

Pour point depressants . . . The paraffinic type of lubricating-oil stock that is widely preferred for engine lubrication is naturally endowed with a high pour point. This usually ranges somewhere between 50° F. to 80° F. This is much too high for practical use, and it is accordingly reduced to somewhere in the neighborhood of 0° F. through the use of any of several well-known dewaxing processes. Dewaxing to pour points lower than 0° F. is uneconomical. To provide desirable low-pour-point properties, pour-point-depressant additives are generally employed in amounts ranging from 0.1 to 1.5 per cent.

When paraffin-type oils are cooled, the waxy constituents therein crystallize into miniature spears and plates. These form a matrix which serves to trap oil in a manner similar to the way that a sponge traps water. Further, the paraffin solids seem to have adsorptive surface characteristics that cause jelling of the adjacent oil.

Pour depressants function by depositing a film on the wax crystals as they begin to form. This, in turn, prevents the wax crystals both from coagulating into larger crystals and from adhering to one another. Thus, particle size is reduced and a matrix "sponge" does not form. This, in effect, gives a slurry of very-small paraffin particles in the oil, and the oil remains in a fluid state. Two types of molecules which accomplish this are shown in Fig. 4.

Pour depressants are of greatest benefit in the lighter grades of oil and are of little benefit in the heavier grades. In some cases, this is because heavier oils become so viscous that they will not pour. In such instances, and likewise with wax-free naphthenic-type oils, pour-point depressants show little or no effect.

Author is with E. I. du Pont de Nemours & Co., petroleum chemicals division.

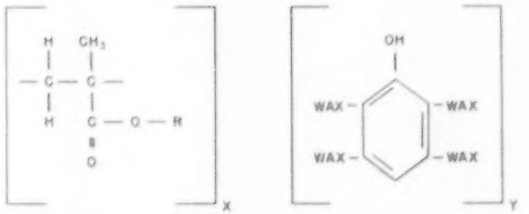

FIG. 3—Typical viscosity-index improvers.

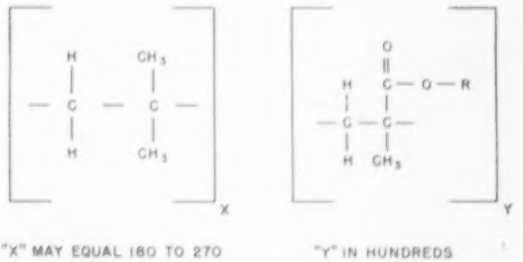

FIG. 4—Typical pour-point depressants.

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OIL SHOW

CASPER

June 23-26

Among the

Drilling Contractors

A. W. Williams Drilling Co., Inc., Mobile, Ala., has a rig under contract to A. R. Temple, of Biloxi, Miss., for a wildcat test 7 miles northwest of Leakesville, in Greene County, southeastern Mississippi. The test, second for Temple in the area, is scheduled to go to 4,500 ft., or through the Wilcox.

C. G. Glasscock Drilling Co., Corpus Christi, Tex., has the contract for Shell Oil Co.'s projected 12,500-ft. test in the Gulf of Mexico, off Nueces County, lower Texas coast. Location is in State Tract 884, about 2½ miles from shore, and 11 miles south of Port Aransas. It is slightly more than a mile northwest Gulf Corp.'s offshore gas-discovery well, completed last October in Tract 889.

Big X Drilling Co. has a new wildcat job going for Carter Oil Co. on the west side of the Hugoton gas area in western Texas County, Oklahoma Panhandle. It is a 5,000-ft. Mississippian test. Location is at 1 Hurley Unit, in 7-5n-11eCM, 12 miles east of Sturgis. Nearest production of any kind is 4½ miles to the southwest at Eva.

Patton Drilling Co. is putting down a 5,000-ft. Mississippian test for Barbara Oil Co., of Wichita, Kans., at a wildcat location 8½ miles southeast of Greensburg, in Kiowa County, western Kansas. Location, at 1 Conklin, in 11-29s-17w, is 4 miles southeast of Brenham gas field, nearest production.

Rainbow Drilling Co., El Dorado, Ark., has a rig working at a rank wildcat location north of Star City, in western Lincoln County, South Central Arkansas. It is a contract job for William L. Durham, of Star City. Listing is for 1 Tarver, in 5-9s-7w. Hole is scheduled to go to 4,000 ft., or top of the Paleozoics.

Thomas P. Pike Drilling Co., Los Angeles, is moving a rig from California to northwestern Oregon for a test it will drill for Standard Oil Co. of California. Location is 10 miles southwest of Astoria, in Clatsop County, and about 70 miles northwest of Portland. Standard lists the test as 1 Hoagland Unit, with location in 11-7n-10w.

Circle Drilling Co., Lake Charles, La., has a new deep wildcat test under contract for Frankfort Oil Co. Location is in the coastal marshes of southern Cameron Parish, Louisiana, about 2 miles north of Mud Lake field. It is listed as 1 Lutcher-Moore, with location in 25-14s-12w. Hole is projected to 13,000 ft.

Delta Drilling Co., Tyler, Tex., has a new wildcat operation under way 4 miles north of Tullos-Urania field, Caldwell Parish, North Louisiana. The

Dressed-up crews on Falcon Seaboard Drilling Co.'s Rig 24, drilling for Blackwood & Nichols on a deep wildcat test, 1 Lanier, 12 miles southeast of Chickasha, in Grady County, Oklahoma. Front row, left to right: J. W. Clinton, James Hood, David J. Allen, and Neal Necessary. Back row, same order: O. S. Airington, Jack Rake (driller), Tillman Heirston (driller), E. B. Pierce, Dean Wallace, and Raymond Knapp (tool pusher).

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test, being drilled for its own account, will be carried to the Tuscaloosa (basal Upper Cretaceous) formation with a depth of about 7,200 ft.

Frio Drilling Co., San Antonio, has a new wildcat operation under way in Jim Wells County, South Texas. It is a contract job for Carrl Oil & Shore Exploration Co., of Corpus Christi, Tex., at 2 Skinner, in La Trinidad Grant. Location is 6½ miles southwest of Ben Bolt. Contract is for 6,500 ft.

Production Maintenance Co., Houston, is getting under way on an 8,200-ft. contract job 3½ miles northwest of Barker, in western Harris County, Texas Gulf Coast. The test, 1 Weingarten, is being drilled for Holmes Drilling Co., also of Houston. Location is 3¼ miles southwest of Joyce Richardson field, and about 2½ miles southeast of North Delhi field.

Kirkwood & Co., San Antonio, is contractor on a new 6,000-ft. wildcat test M. E. Andrews, Ltd., of Houston, is starting about a mile east of Bridwell Oil Co.'s recently completed discovery well of Bob Cooper field, about 14 miles southwest of Falfurrias, Brooks County, South Texas. Location is listed as 1 Cage Ranch, in Survey 701.

Carmack Drilling Co., Casper Wyo., has a new wildcat test drilling for Continental Oil Co. in northeastern New Mexico. Location is at 1 Springer, in 11-28n-21e, about 8 miles east of Dawson, and south of Raton, in Colfax County. Objective is the Morrison formation.

Delta Gulf Drilling Co., Tyler, Tex., is drilling for Columbian Carbon Co. on a wildcat test in the Sunset area, 5 miles southwest of Leonville, in St. Landry Parish, South Louisiana. The test, 1 Horaist, in 87-7s-4e, is 3 miles northwest of production at Arnaudville. Permit is for 10,500 ft.

Wilson-Davis Drilling Co., Jackson, Miss., is to drill a 6,000-ft. wildcat test in northern Adams County, southwestern Mississippi, on a joint operating arrangement with Donold M. Davis and Dave Gammill. Location, at 1 Stowers, in 4-8n-2w, is 1½ miles west of Church Hill field, about 10 miles northeast of Natchez.

Kerr-McGee Oil Industries, Inc., Oklahoma City, has taken on another offshore drilling contract, this one a 14,000-ft. test for Forest Oil Corp. Location is in Block 4, East Cameron area, off Cameron Parish, Louisiana. It is about 4 miles southeast of Forest's deep Crab Lake gas-distillate field, on shore.

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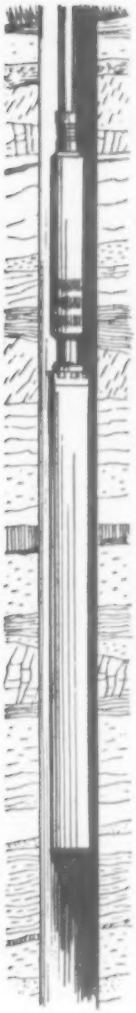

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Pipeline Patrol

. . . Report on Construction

Articulated Scraper Gets Ready for Journey

This pig, very infrequently called an articulated scraper, is being put into a sending trap from which it will be discharged into Cities Service Oil Co.'s 20-in. crude-oil line from Sour Lake, Tex., to Lake Charles, La. Forced through by the pressure of the moving oil, this pig will clean the accumulation of gook that forms fast enough to warrant to a trip by the pig every 60 days. The pig is equipped with steel bristles and is designed to go around sharp bends in the line.

Under Way, Contracted, and Planned

PIPELINE activity as reported below by The Oil and Gas Journal is compiled from information received from pipeline companies and contracting firms.

These projects include those planned, proposed, under way, and contracted. Uncontracted projects are indicated by • preceding the job.

Crude-Oil Pipelines

Ar-Mex Pipe Line Co.—Company has applications for two lines before the Office of Defense Mobilization Board for rapid amortization approval.

1. A crude-oil line from Albuquerque, N. M., to Phoenix, Ariz. This line would serve a 20,000-bbl. refinery being planned by Frost & Associates of Dallas.

2. A crude-oil line from Guernsey, Wyo., to Albuquerque.

• **Big Horn Pipe Line Co.**—Firm has asked Wyoming Public Service Commission for permission to build a 150-mile, 8-in. crude-oil line from Ash Creek field, Wyoming, to a connection with Service Pipe Line Co.'s line at Midwest, Wyo.

• **Butte Pipe Line Corp.**—This joint venture of Shell Pipe Line Corp. and Murphy Corp. has announced plans for a 450-mile, 16-in. line from eastern Montana to Wyoming. The line will deliver to big-inch carriers which start in eastern Wyoming.

Magnolia Petroleum Co.—Company has let contracts on 215-mile, 12, 14, and 16-in. crude line from Midland to Corsicana, Tex. O. R. Burden Construction Corp. has the western half of the line and H. B. Zachry Co. has the eastern half. Work is scheduled to be finished by October.

Magnolia Petroleum Co. — This company will operate a 48-mile, 12-in. submarine pipeline for itself and Continental Oil Co., and Newmont Oil Co. The line will run to blocks off the coast of St. Mary's Parish, Louisiana, and will have a capacity of 50,000 bbl. per day. Brown & Root, Houston, has the contract and expects to be finished by the middle of 1955.

• **Malco Pipeline, Inc.**—Company is planning a 40-mile, 4-in. line from South Blanco Tocito field in Rio Arriba County, New Mexico, to Bloomfield, San Juan County, New Mexico. Completion set for 1955.

Skelly Oil Co.—Company started work this month on 27½-mile, 12-in. line from El Dorado, Kans., to Harvey County, Kansas. Completion is set for May.

Pipeline Patrol

Standard Pipe Line Co.—Company plans to build two crude lines. Applications are now before the Office of Defense Mobilization for rapid amortization approval.

1. A 350-mile, 16-in. crude line from Glendive, Mont., to Guernsey, Wyo., to connect with Platte Pipe Line Co.'s system there.

2. A 330-mile, 16-in. crude line from Wink, Tex., to Albuquerque, N. M. This line would serve a 10,000-bbl. refinery being planned by Frost & Associates of Dallas.

Trans Mountain Pipe Line Co.—Engineers Limited Pipeline Co. has contract to lay 27 miles of 20-in. from Laurel to Burlington, Wash., and 9 miles of 16-in. of lateral to Shell Oil Co.'s new refinery at Anacortes, Wash. The $2,750,000 job will begin in spring and end July 31.

• **West Coast Pipeline Co.**—The off-again-on-again plans for this crude line from near Wink in West Texas to near Norwalk in California are presently before the Office of Defense Mobilization. A three-man board of nonindustry members recently recommended that the project be dropped. They questioned the ability of West Texas to produce enough crude to supply both the East and West Coasts in time of war. The three-man board favored building a line from California's Elk Hills Naval Reserve to be held in standby for possible future need.

Products Pipelines

• **American Pipe Line Co.**—Has received ODM approval to amortize 40 per cent of $178,000,000 with a rapid writeoff on proposed line to run from Gulf Coast area to New York City area. Bids for pipe requested.

• **H. W. Bass & Sons, Inc.**—Company is planning on a 152-mile, 4-6-in. L.P.G. line from Goliad Corp.'s plant in Live Oak County, Texas, to Corpus Christi.

• **California - Oregon Pipe Line System.**—103 miles 6-in., proposed, Crescent City, Calif., to Medford, Ore.

• **International Pipe Line, Inc.**—132 miles, 8-in., proposed, Wrenshall to Minneapolis, Minn. Cost: $4,200,000.

• **Keystone Pipe Line Co.**—Company has ODM writeoff of 25 per cent for $1,875,000, 48-mile, 8-in. products line from Boot, Pa., to the Fullerton, Pa., terminal.

Moore Stoner Co.—Company has $2,500,000 tax amortization for a 200-mile, 6-in. products line from a connection with Oil Basin Pipe Line Co.'s terminal at Glendive, Mont., to Minot, N. D.

Okan Pipe Line Co.—This subsidiary of Warren Petroleum Corp. has awarded work to two contractors for its L.P.G. line from western Oklahoma and Kansas to Tulsa. Vaughn & Taylor Construction Co. has 260 miles of 3 to 6-in. gathering lines, and R. H. Fulton has 140 miles of 6-in. transmission line from western Oklahoma into Tulsa.

• **Products Pipe Line Co.**—This subsidiary of Goliad Corp. has received a fast writeoff for 40 per cent of $126,000 and 25 per cent on $1,781,000 for L.P.G. line from the Wilcox natural-gasoline plan in Lavaca County, Texas, to Texas City. Panama-Williams Co. has contract. Completion scheduled for midsummer.

Shell Pipe Line Corp.—65 miles of 12-in. products line from Baton Rouge, La., to Shell's Norco refinery. Houston Contracting Co. has contract. H. T. Muckley, Supt. Job to be completed in June.

Sioux Oil Co.—Company will build a 55-mile products, 8-in. line from its Newcastle, Wyo., refinery to Rapid City, S. D.

Southern Pacific Pipe Lines, Inc.—This subsidiary of Southern Pacific Railroad Co. has announced plans for 800 miles of products line from Los Angeles to El Paso. Line sizes are 16-in. from Los Angeles to Colton, Calif., 12-in. from Colton to Phoenix, Ariz.,

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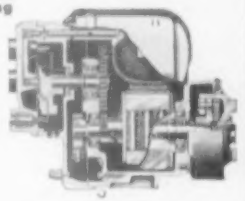

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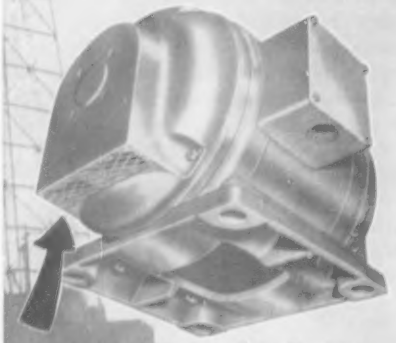

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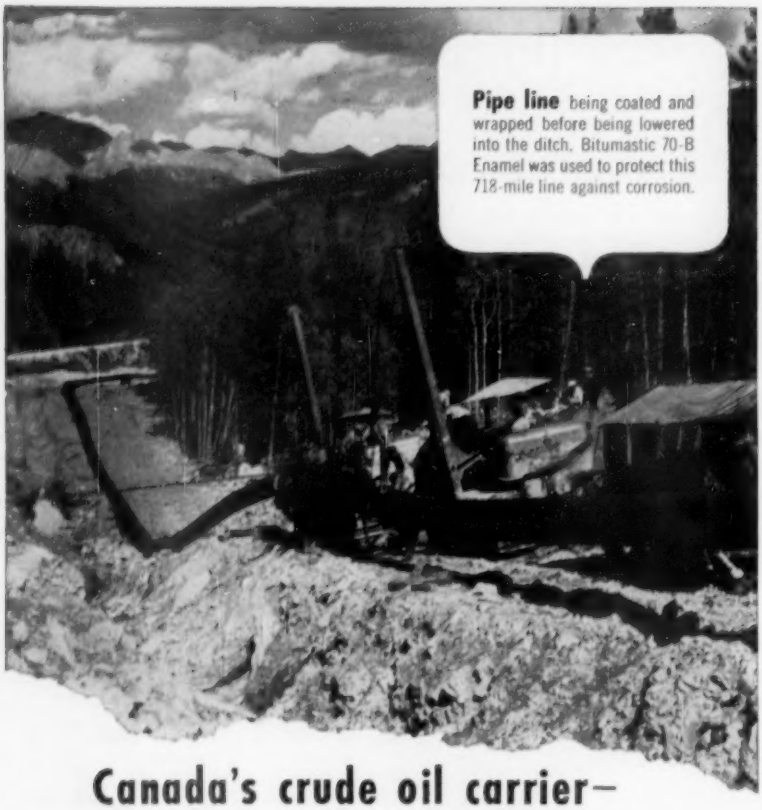

Pipe line being coated and wrapped before being lowered into the ditch. Bitumastic 70-B Enamel was used to protect this 718-mile line against corrosion.

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Pipeline Patrol

and 10 and 8-in. from El Paso to Phoenix. Products will be pumped both ways into Arizona.

• **Sunflower Pipe Line System.**—Company proposes to build a 215-mile, 6-in. line to transport L.P.G. from six counties in western Kansas to Wichita. Application approved by Kansas Corporation Commission.

Texas Eastern Transmission Corp.—Company has received Federal Power Commission approval to abandon the "Little Inch" gas line and to convert it to products service. The company will spend $13,000,000 converting the line back to products. When finished the line will have a capacity of 235,000 bbl. daily.

U. S. Gov't. Alaskan Products Pipe Line.—600 miles of 8-in. under way from Haines northward through Yukon to Fairbanks, Alska. Williams Bros., McLaughlin, Inc., and Marwell Construction Co. are doing the work. Pipeline work completed. Line will go into operation about May 26.

Natural-Gas Pipelines

• **Alabama-Tennessee Natural Gas Co.**—Company has proposal before FPC to lay 21 miles of 12-in. line west from its present line in Colbert County, Alabama.

• **American-Louisiana Pipe Line Co.**—1,121 miles of 30 and 22-in., 30-in., proposed, extends from North Tepetate, Acadia Parish, Louisiana, to near Detroit. The 22-in. starts near Payne, Ohio, extends to Bridgman, Mich. Estimated cost: $130,000,000. FPC approved.

• **Arkansas Louisiana Gas Co.**—136 miles of new line proposed, to be added to present system in Arkansas, Louisiana, and Texas. Estimated cost: $9,245,166. FPC approved.

• **Atlantic Seaboard Corp.**—Company has filed with FPC for permission to loop 84 miles of its existing 26-in. line in West Virginia, Virginia, and Maryland.

• **Carolina Natural Gas Corp.**—185 miles 2-12-in., proposed lateral lines off Transcontinental in North and South Carolina.

• **Central Hudson Gas & Electric Corp.**—Company has filed application with FPC to construct 48 miles of 12-in. line from Albany to Kingston, N. Y. Line will be started and completed in 1955 if FPC approves.

• **Cities Service Gas Co.**—Company has applied to the Federal Power Commission for permission to build a 93-mile, 26-in. natural-gas line from Blackwell, Okla., to Independence, Kans. The company also proposes to build a 145-mile gathering system in Woods County, Oklahoma, and Barber County, Kansas. The two jobs will cost $8,422,400.

• **City of Dalton, Ga.**—Proposes to build 39 miles of 8-in. from a point of interconnection with Southern Natural's Rome-Calhoun transmission line. Estimated cost: $2,940,000.

• **Clinchfield Coal Corp.**—Company has filed permit with Federal Power Commission for authority to build 16-mile, 12-in. line from Dickenson County, Virginia, to near Osborne Gap, Ky. The company is primarily a coal producer.

• **Coastal Transmission Co.**—Company plans to build 550 miles of 30-in. line from near McAllen in South Texas to near Baton Rouge (See Houston, Texas Gas & Oil Co.)

• **Colorado Interstate Gas Co.**—Company has received recent FPC permission to change an application already approved by the commission. The company had planned to build 365 miles of 22-in. natural-gas line from Pacific Pipeline Corp.'s system at Rock Springs, Wyo., to Denver, where Colorado-Wyoming Gas Co. would pick it up. The line would have gone southwest of Laramie, Wyo. As now authorized, the line will be relocated to pass near Cheyenne, Wyo., and then to Denver. Deliveries will be made to Colorado-Wyoming near Cheyenne and at Greeley, Colo. The project will cost $24,146,821.

Colorado Interstate Gas Co.—Company is also spending $4,200,000 extending its gathering lines in the Panhandle of Texas, Oklahoma, and Kansas. Work will be done this summer.

• **Colorado-Western Pipe Line Co.**—454 miles of undetermined size pipe planned between Cortez in Montezuma County and Denver. Line would serve towns of Montrose, Gunnison, Salida, Fairplay, and South Platte, Colo. Estimated cost: $30,000,000. Company also plans 254 miles of laterals to service Colorado cities not now receiving natural gas.

328-mile line, proposed, to run from a point in La Plata County in southwestern Colorado over the Continental Divide along the eastern slope to serve Pueblo, Colorado Springs, and Denver. Estimated cost: $21,600,000.

East Ohio Gas Co.—Company has let contract to Williams Brothers Co. to lay 112 miles of 30-in. from Maumee, Ohio, to Cleveland. Completion is set for October 1.

• **El Paso Natural Gas Co.**—Company has future plans for a 370-mile, $35,000,000 line from Mountain Home, Idaho, to Reno, Nev. The company will buy the gas from Pacific Northwest Pipeline Co.

• Company plans to build 74 miles of natural-gas line and 6,925 additional compressor hp. in Texas, New Mexico, and Arizona. The cost will be $13,869,017. FPC approval received.

Empire Southern Gas Co.—Company is laying 36 miles of 6, 4, and 2-in. gas line near White Deer, Tex. Job is slated to be completed May 1.

• **Hope Natural Gas Co.**—Proposing to build a 22½-mile extension of existing line from Boone County, West Virginia, to Logan-

New MOORLANE MULTI-TUBE
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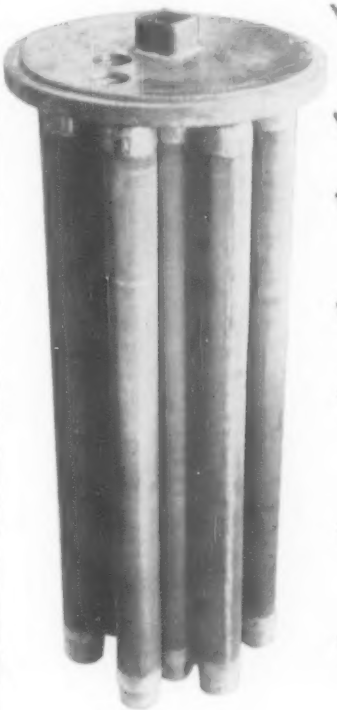
PRODUCTS PIPE LINES
Filters dirt, pipe scale and heavier particles



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- Filter element can be cleaned *in the strainer* by backwashing.
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- Capacity of unit more than twice conventional strainer of same size.
- Very low pressure drop during operation.
- On a barrel per dollar basis, the cost is much lower than conventional strainers.
- Can be designed to filter minimum particle size specified.
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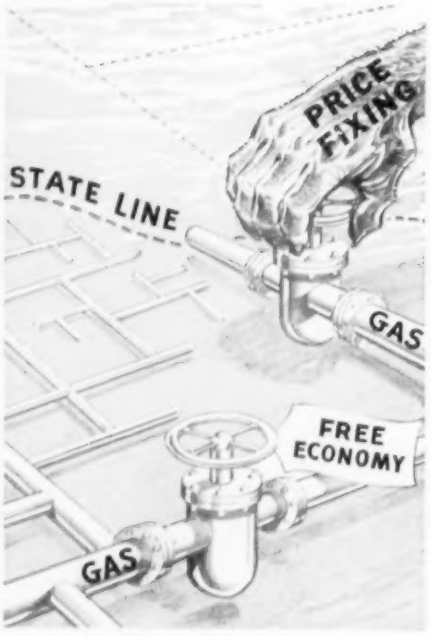
Choice of Product Should Be the Privilege of its User!



ECONOMISTS of the Empire Trust Company calculated that in the United States, 33,000,000 families cook with gas; 18,000,000 heat water with it; 14,000,000 use it to heat their homes; while 4,000,000 get refrigeration from it. The statistics include all types of gas.

Impressive as they are, they are but an indication of a trend. In the Southwest where it is convenient, 60 per cent of homes use natural gas. In other areas, only 5 per cent of the homes are served with natural gas. The potential is more impressive than the accomplishment.

In just four large cities, 270,000 householders are on lists waiting for natural gas service. This is part of the evidence which justified the prediction that the natural gas industry would have a five-fold expansion between 1950 and 1975. That could be accomplished by providing sufficient transmission systems out of the Southwest, which provides 33 per cent of the nation's natural gas.

The prospect took a different hue when the heavy hand of price fixing came down on the gas producer through the decision of the United States Supreme Court in the Phillips case. Some gas producers immediately cancelled their contracts, which provided for that contingency in the case of federal control. Some state and city officials are now asking the Federal Power Commission to compel continuation of deliveries.

Whatever the outcome of that question, it is certain that some gas producers are not going to make new contracts since, under price fixing, they have no voice in determining the price of their product.

So instead of the home owners of the United States being free to select the fuel they prefer, price fixing by a Government bureau is cutting down the supply of the most efficient fuel—Natural Gas.

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Pipeline Patrol

Mingo county line, West Virginia. Estimated cost: $930,000.

• **Houston, Texas Gas & Oil Co.**—Company plans to build 600 miles of 30-in., and 350 miles of 18-24-in. line to carry natural gas from Baton Rouge to Miami. Line will join with Coastal Transmission's proposed line from McAllen, Tex.

• **Kansas-Nebraska Natural Gas Co., Inc.**—Proposes to construct 206 miles of 6-12-in. pipeline to add to present system in central and northeastern Nebraska.

• **Lone Star Gas Co.**—Firm has applied to FPC for permission to build a 230-mile natural-gas line from Cotton County, Oklahoma, to Fritch, Tex. The line would deliver gas from Lone Star's connections in the Golden Trend fields in Oklahoma to Natural Gas Pipeline Co. of America at Fritch.

• **Michigan Consolidated Gas Co.**—25 miles, 12-in., proposed, from near Sparta to Muskegon, Mich.

• **Michigan Gas Storage Co.**—Company has applied to FPC for permission to construct 36 miles of 16-in. natural-gas line from Mount Pleasant Junction to Milwaukee, Mich. The project will cost approximately $2,572,000.

• **Michigan Wisconsin Pipe Line Co.**—251 miles, proposed, 24, 18, 12, 6, and 4-in. loops. Majority will be in Wisconsin.

• **Missouri Public Service Co.**—136 miles, 8-10-in., proposed, New Franklin to Trenton, Mo.

• **Natural Gas Pipeline Co. of America.**—Company plans to start work in July on 350 miles of 20 and 26-in. line from Wise County, East Texas, to its station 111 at Fritch, Tex. Job expected to be completed by December.

• Company also plans to start 31 miles of 36-in. in July from Herscher, Ill., to a connection with Texas Illinois pipeline near Joliet, Ill. Job slated to be finished in November.

Nevada Natural Gas Co.—Company plans looping program along its 114-mile line from Needles, Calif., to Las Vegas, Nev. Mileage and size are unknown but cost will be about $2,500,000.

• **New River Gas Co.**—50 miles, planned, Summers to Monroe counties, West Virginia, to Narrows and Dublin, W. Va.

• **New York State Natural Gas Corp.**—Company plans to start laying in June 18 miles of 20-in. pipe from Homer, Cortland County, New York, to its station in Otisco, Onondaga County, New York.

• Company also has plans for 21 miles of 20-in. from Genessee Falls, Wyoming County, New York to York, Livingston County, New York. No definite starting or completion dates announced.

• **Niagara Mohawk Power Corp.**—Company plans no major transmission lines for 1955. However, itp lans to add more than 300 miles of distribution mains.

• **North Indiana Fuel & Light Co.**—Company has awarded H. L. Gentry Construction Co. 30 miles of 10-in. and 15 miles of 6-in. natural-gas lines. Work will be completed near the middle of June.

• **Northern Natural Gas Co.**—Company has the following jobs before the FPC for approval.

• Canadian Extension—188 miles of 24-in. from Canadian border to near Wahpeton, N. D. 215 miles of 30-in. from Wahpeton to Farmington, Minn.

• South Dakota Extension—94 miles of 12-in. from Sioux Falls to Waterton-Huron. 71 miles of 10-in. from Waterton-Huron to Duluth-Superior.

• Duluth-Superior Extension—167 miles of 24-in. from Farmington to Duluth-Superior.

• **Northwest Alabama Gas District.**—40 miles, 9-in., proposed, Southern Natural's line through Winfield to Haleyville, Ala.

Pacific Gas & Electric Co.—Company is working on 18 miles of 12-in. from Beehive Bend field to W/O Gridley in California. The job is slated for completion in September.

• Company plans 21 miles of 16-in. line from Marysville to Lincoln, Calif. Job will start in June and wind up in September.

• Company's long-range plans call for looping the Topock-Milpitas line with 135 miles of 34-in. The major part of the line will be laid in 1956, while 62 miles will be laid in 1957.

• **Pacific Northwest Pipeline Corp.**—1,466 miles, proposed, Ignacio, Colo., to Bellingham, Wash. Approved by FPC.

380 miles, proposed, laterals and spurs off main line to Pocatello, Idaho, to Yakima, Wash.

• **Panhandle Eastern Pipe Line Co.**—Company has plans to loop Peoria lateral before FPC now. The line would be 16-in. pipe running 58 miles from near Springfield to Peoria, Ill.

• **Pine Tree Natural Gas Co.**—204 miles of undetermined size pipe to run from the Boston area to Bangor, Me.

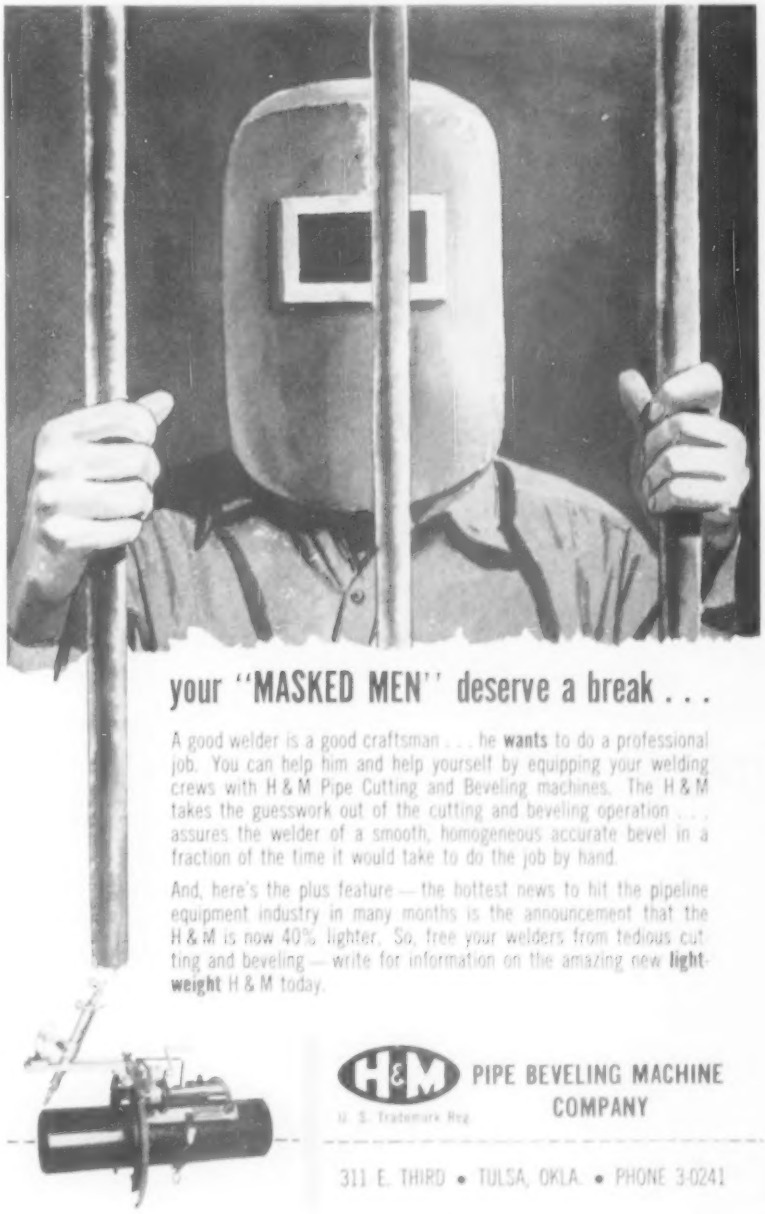
Private Interests.—Proposes to build gas line from Gubik gas field near Navy Petroleum Reserve No. 4 in Alaska to Fairbanks. Line would be 450-mile, 8-in. line and Arctic Contractor, Inc., who handled engineering requirements and preliminary design, estimated the line would cost $20,000,000, although later figures have been much higher than this.

South Georgia Natural Gas Co.—Company has let contracts on work approved by the FPC in 1954. The total cost of the projects is nearly $9,000,000.

Buchanan Pipe Line Co. has 85 miles of 3, 6, and 8-in. line in the State of Georgia.

Hallmac Construction Co. has 97 miles of 10-in. line from Albany, Ga., to Ellaville, Fla.

Mid-States Construction Co. has 110 miles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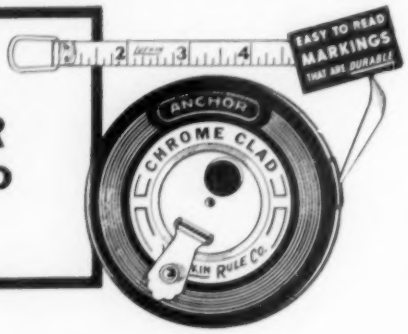

Jet black markings on the Lufkin "Anchor" Chrome Clad are bonded to the tempered steel line and stand out sharp and clear against the no-glare, chrome-white background. The "Anchor" is strong, and durable too, because the line is built up with a series of platings for extra protection and strength. Genuine leather, mahogany-colored, is hand-stitched over rust-resistant metal case liner. Folding flush handle opened by push pin. A fine tape combining strength, durability, accuracy and beauty. Available with graduations either in feet, 10ths and 100ths; or feet, inches and 8ths.

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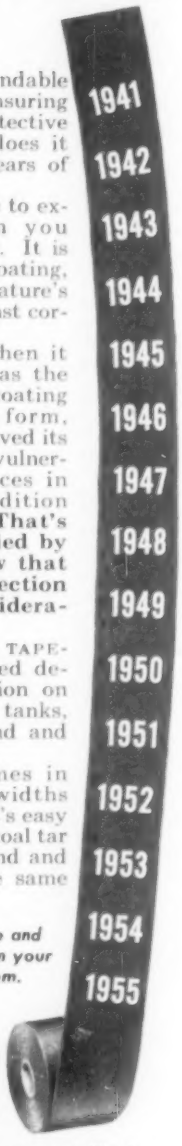

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Pipeline Patrol

of 2, 4, 6, and 12-in. line in Alabama and Georgia. Seventy-one miles of the line is 12-in. from Phenix City, Ala., to Americus, Ga.

Thomason & Associates, of Montgomery, Ala., has 35 miles of 12-in. and about 8 miles of smaller in Alabama and Georgia.

Tennessee Gas Transmission Co.—Company has awarded Oklahoma Pipe Line Constructors 113 miles of 24-in. natural-gas line from near Covington to Laska-Waxen, Pa. The work has started.

Company has also awarded H. C. Price Co. 130 miles of 24 and 26-in. pipeline in Ohio and Pennsylvania.

• Company has also received FPC permission to construt a 30-in. line, 370 miles long from Agua Dulce, Tex., to Kinder, La. The line will cost $35,400,000.

• **Tennessee Gas Transmission Corp.**—Firm has requested FPC permission to spend $56,000,000 in new pipeline and compressor facilities. The work will include 221 miles of 26 and 30-in. loops in Kentucky and Ohio and 376 miles of gathering lines in Louisiana and Texas. Some 12,540 hp. would be added at new and existing compressor stations in Louisiana, Mississippi, and Texas.

• **Texas Eastern Transmission Corp.**—Proposed, 382-mile, 24-in. line from Kosciusko, Miss., to Beaumont, to connect with the existing 30-in. line there to Connellsville and replace the "Little Inch" in moving natural gas. The project will cost $71,000,000.

• **Texas Gas Corp.**—This firm will spend $3,500,000 on a line from Orange, Tex., to a connection with a new line of Transcontinental Gas Pipe Line Corp. in Cameron Parish, Louisiana. The project will call for crossing the Sabine River, building a compressor station, and a measurement station.

Texas Gas Transmission Corp.—Company has big building program set to start soon and end approximately November 1.

From Covington, Ky., to Jefferstown, Ky., company will build 77 miles of 26-in.

Company will loop 14 miles of 20-in. at Haughton, La.

Will build 72 miles of 12-in. from Hardinsburg, Ky., to Bedford, Ind. Also will build 5 miles of 8-in. near Bedford.

From Bastrop, La. to Clarksdale, Miss., the company will lay 50 miles of 30-in.

From Eunice, La., to Morgan City, La., the firm will lay 105 miles of 20-in.

Transcontinental Gas Pipe Line Corp.—Company has awarded the following contracts to lay 315 miles of 36-in. and 219 miles of 30-in.

O. R. Burden Construction Corp. will lay 5.31 miles of 36-in. and 25 miles of 30-in. in Louisiana.

Associated Pipe Line Contractors, Inc., will lay 63 miles of 36-in. in Louisiana and Mississippi and 71 miles of 30-in. in Virginia and Maryland.

Midwestern Constructors, Inc., will lay 14 miles of 30-in. and 54 miles of 36-in. in Alabama and Georgia.

Western Constructors will lay 77 miles of 36-in. in Georgia and South Carolina.

Panama-Williams Co. will lay 36 miles of 30-in. and 31 miles of 36-in. in South Carolina and North Carolina.

Williams Brothers Co. will lay 72 miles of 30-in. in Virginia.

United Gas Pipe Line Co.—Company has started work on 14 miles of 12-in. from Pescadito Junction to Laredo, Tex. Job will be finished June 1.

• Company has applied to FPC for permission to construct 63 miles of 16 and 20-in. natural-gas line in Mississippi, Alabama, and Florida. The company will also add 330 hp. to its compressor stations. Cost for the job will be about $8,300,000.

• **Utah Natural Gas Co.**—Planning 40

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PIPELINE CONTRACTORS are establishing new standards of fast, economical performance with the big-capacity Cleveland Model 190 Backfiller on the largest pipelines. It's paying off on the smaller lines, too.

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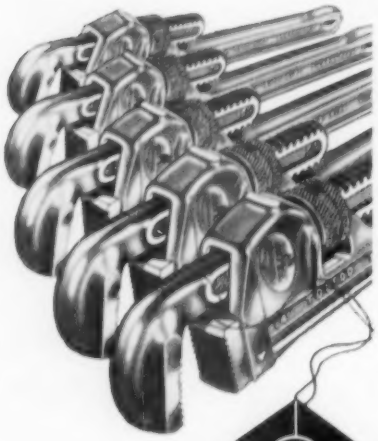

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Pipeline Patrol

miles from Orem to Salt Lake City, 16-in. pipe at later date. Contract not yet let.

Virginia Natural Gas Co.—153 miles, Buckingham to Richmond and Portsmouth, Va.

Wilcox Trend Gas Gathering System, Inc.—Company is spending over $1,000,000 building gas-gathering lines and compressor stations in the Cuero-Goliad area of South Texas.

Foreign Crude-Oil Pipelines

• **Atlas-Dresser.**—Included in this company's agreement with the Argentine Government are plans to build a 400-mile, 16-in. crude line from Plaza Huincul area to Bahio Blanca.

• **Peace River Oil Pipe Line Co., Ltd.**—Company has been granted a permit to lay a 106-mile line from Sturgeon Lake field in Northwest Alberta to the Edson pumping station of Trans Mountain Oil Pipe Line Co., Ltd. The project will include a 16-in. line from Sturgeon Lake to Iosegun Lake and a 12-in. line from there to Edson. Capacity will be 58,000 bbl. daily.

• **Petroleos Mexicanos.**—145 miles, 12-in. considered, 18 de Marzo field via Reynosa to Monterrey, Mexico.

100 miles, planned, Isthmus of Tehuantepec, Jose Colomo to El Plan field, Minatitlan.

72 miles, 12-in., proposed, Poza Rica to Atzacapotzalco, Mexico.

• **Standard - Vacuum Oil Co.**—Company has long-range plans for a 90-mile pipeline to give the new Lirik field in Central Sumatra an outlet. Completion is not scheduled before 1957 or 1958.

Texas Petroleum Co.—Contract has been let to Foster Wheeler Corp. and Panama-Williams for a 119-mile, 12-in. crude line to move oil from Velasquez field in Colombia to a connection with the main Andian National system at Galan. Est. cost: $6,000,000. Completion set for May.

Yacimientos Petroliferos Fiscales Bolivianos—Williams Brothers Co. is winding up work on a 6-in. line from Camiri field to Yaciuba on the Argentina border. The line is expected to be completed by May.

Williams Brothers also has contract to build a 230-mile, 6-in. products line from Cochabamba-Oruro-La Paz. The line will cost approximately $7,000,000. The Bolivian Government will eventually add a 10-in. products line from Oruro to Arica, Chile.

• **Others.**—For plans for further crude lines in Canada that have not yet been fully formulated, see The Oil and Gas Journal, April 4, page 79.

Foreign Products Pipelines

• **Empresa Nacional del Petroleo.** — 80 miles, 6⅝-in., planned, Concon to Santiago, Chile.

• **Governments of South Rhodesia and Portuguese East Africa.** — 200 miles, considered. Beria, Portuguese Mozambique to Umtalia, Southern Rhodesia.

• **National Fuel Oil Co.**—This company in Israel is a shareholder in a company which plans to build a products line between Haifa and Tel Aviv. The plans call for a 55-mile 6-in. line in which the Government would own 10 per cent.

• **National Iranian Oil Co.** — Company plans $32,300,000, 573-miles, 10-in. products pipeline from Ahwaz to Teheran, Iran. The line will have a capacity of 40,000 bbl. daily. Costain-John Brown, Ltd., London, will build the 337-mile southern part. Entrepose, Paris, will build the northern 236 miles.

• **North Atlantic Treaty Organization (NATO).**—This defense organization is building products lines to airforce bases in various parts of France. Approximately 2,000 miles of 4-10-in. line will be laid.

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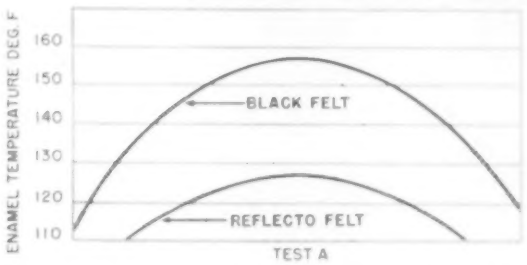

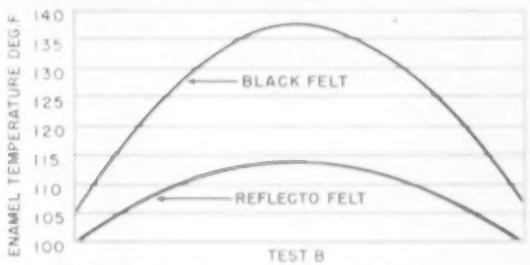

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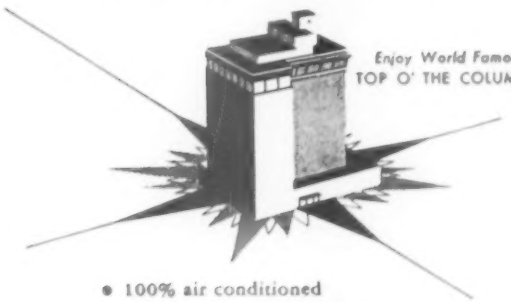

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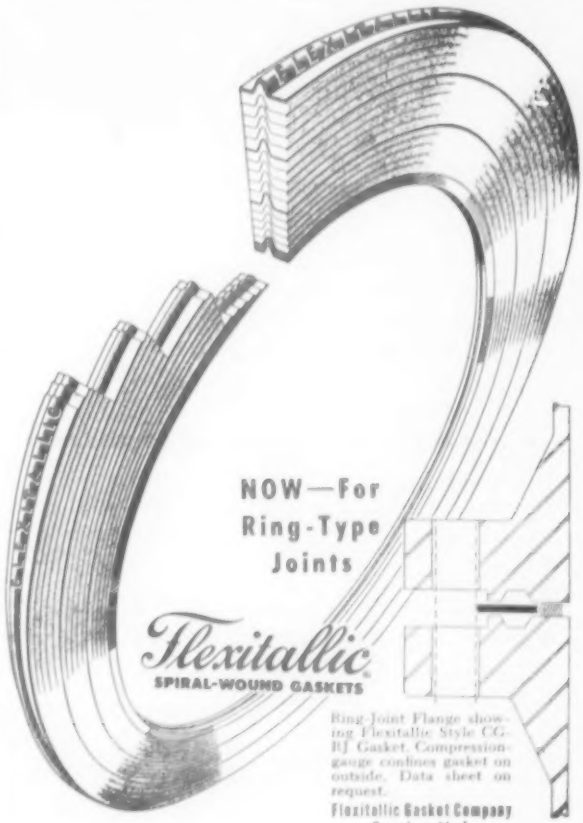

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- lower operating costs
- utmost safety

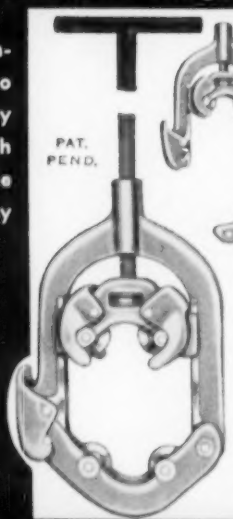
Our detailed proposal for increasing the efficiency of your compressor will be sent you without obligation. Send us the name, bore, stroke, and speed of your machine.

J. H. H. VOSS VALVES
REG. U.S. PAT. OFF.

VOSS VALVES / J. H. H. VOSS Co., Inc. 785 East 144th Street, New York 54, N. Y.

IF YOU CUT LARGE DIAMETER PIPE...
YOU NEED THESE
New REED HINGED 4-WHEEL PIPE CUTTERS
Four sizes cover the range from 2½" to 12"

Users tell us these completely new cutters are so efficient they often "pay for themselves" through the savings in crew time on a half-dozen cuts. They are the first really practical tools for cutting off steel or cast iron pipe in sizes from 2½" to 12". You can, for example, cut 8" steel pipe completely off in less than five minutes.



Four wheel design requires minimum swing of handle—less digging in ditch work, easier "tight-corner" cuts.

Closed frame permits light weight with complete rigidity for better cutting.

4-point guide aligns the cutter on the pipe . . . assures perfect tracking and a right angle cut.

Reed Razor Blade wheels track perfectly, cut easily and roll down burr on steel pipe.

Unconditionally guaranteed to be the most efficient cutter you have ever used. Ask your jobber or write for literature.

REED MANUFACTURING COMPANY
ERIE, PENNSYLVANIA • U. S. A.

Pipeline Patrol

Oleoducto del Pacifico, S.A.—Company is building 100-mile, 6 and 8-in. products line from Buena Ventura to Cali, Colombia. Pipeline Engineering Co. of Dallas, Tex., has the contract.

Overland Pipeline Corp.—This South African firm has requested government permission to build a 350-mile line, to cost $8,450,000, from the South African coast to Rand, a plateau area in southern Transvaal where there is heavy petroleum consumption.

• **Petroleos Mexicanos.**—124 miles, 6-in. planned, Lagos to Guadalajara, Mexico.

54 miles, 6-in. planned, Lagos to Aguascalientes, Mexico.

82 miles, 8-in. planned, Salamanca to Lagos, Mexico.

• **United States Government.**—375 miles, 12-in., planned, St. Nazaire to Melun and Metz, France.

• **United States Navy Department.**—Proposed 300-500-mile line to be built in Spain to serve a proposed naval base and four large air bases which are also proposed under a defense agreement with the Spanish Government. No definite size or cost is known now.

Winnipeg & Central Gas Co.—Canadian company plans to build a $20 million butane-propane system. Company plans to get gas L.P.G. from Signal Oil & Gas Co.'s Tioga, N. D., plant and move it to Winnipeg. Size and route of the line has not been definitely established.

Foreign Natural-Gas Pipelines

Alberta Gas Trunk Line, Ltd.—This Canadian firm has let engineering contracts to two firms, Dutton, Williams Brothers, Ltd., and Mannix, Ltd., for a 300-mile, big inch gas-gathering system to collect Alberta's natural gas for transportation to Trans Canada Pipe Line Co.

Attock Oil Co.—Company plans to build 60-mile natural gas pipeline from Dhulian field to Rawalpindi in West Pakistan.

• **Canadian Western Natural Gas Co.**—Firm will begin work this spring on a $1,000,000, 59-mile natural-gas project in southern Alberta. The company will also add a compressor station at Lethridge, Alta.

• **Empresa Nacional del Petroleo.**—80 miles, 10-in., planned, Concon to Santiago, Chile.

Petroleos Mexicanos.—205 miles 16-in. under way. Monterrey to Torreon, Mexico.

• **Petroleos Mexicanos.**—440 miles, 20-in., planned, Brazil to Tampico to Poza Rica, Mexico.

• **Saskathewan Power Corp.**—Firm will build a 115-mile, 14-in. natural-gas line from Coleville gas field to Biggar and Saskatoon. The firm also plans a 105-mile, 10 and 12-in. line from Saskatoon to Prince Albery. The projects are scheduled for completion October 1.

Sui Gas Transmission Co., Ltd.—Morrison-Knudsen Construction Co. has contract to build 350-mile, 16-in. line from Sui field to Karachi in West Pakistan. Est. cost: $25,000,000.

Trans-Canada Pipe Lines, Ltd.—Company has postponed start of 2,250 miles of 24-34-in. line from Alberta-Saskatchewan border to Toronto and Montreal until next year because of financing difficulties. Company also plans a 24-in. lateral from Winnipeg to Emerson, Man. Twenty-inch lateral from Niagra to Toronto now in operation.

• **Westcoast Transmission Co., Ltd.**—Company has signed agreement with Pacific Northwest Pipeline Corp. and has revived plans for its line from the Peace River area of Alberta and British Columbia to the United States border near Sumas, Wash. Plans call for work to begin sometime this year. Company has also announced plans for a second line to parallel the first and to swing east into the Okanagan Valley.

A pencil pokes through this corroded metal! Why chance trouble like this? Cathodic Protection and Anaconda Type CP Cable effectively check corrosion of buried metals.

CHECK CORROSION by cathodic protection with Anaconda Type CP Cable

Corrosion of buried metals costs industry over a *billion dollars a year!*

But most of this can now be prevented—by Cathodic Protection.

Corrosion—caused by minute electric currents flowing from metal into adjacent soil—is checked by applying direct current from an external source. This eliminates anodic areas, makes the entire metal surface cathodic and stops the flow of current from the metal.

But moisture, oil, acids and alkalies often found in corrosive soil areas are tough on cable.

Because of our many years of experience with buried cable, Anaconda has been able to produce a new Type CP cable—specially designed with double jacket of polyethylene and Densheath* (PVC)—to resist these enemies of cable life. This means less replacement . . . major savings in both labor and material costs.

Would you like more information on how Cathodic Protection checks corrosion?. . . and detailed information on Anaconda Type CP Cable? Ask the Man from Anaconda — or send for bulletin DM 5450, "Anaconda Cathodic Protection Cable," Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

* Reg. U. S. Pat. Off.

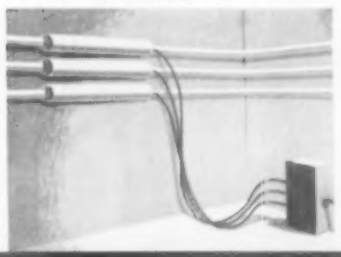
ANACONDA®

COPPER AND ALUMINUM WIRE AND CABLE

Where Anaconda Type CP Cable and Cathodic Protection Cut Corrosion Costs.

Gas mains and water pipes

Lead-covered cable



Underground storage tanks

Transmission towers

5 Advantages make NAYLOR a natural FOR NATURAL GAS LINES

There are five good reasons why Naylor pipe provides plus performance in gas-gathering service.

★ **LIGHT WEIGHT** . . . without sacrifice of strength. Assures easy installation. Saves on handling and transportation.

★ **SAFETY** . . . Naylor's exclusive lockseamed spiralwelded structure acts as a continuous expansion joint to absorb shock loads, stresses and strains.

★ **GREATER COLLAPSE STRENGTH** . . . Naylor's reinforcing spiral truss permits lines to be operated under both vacuum and pressure.

★ **ACCURATE DIAMETER** . . . Naylor's precision construction maintains true cylindrical form in lightweight pipe.

★ **PIPE ENDS** of standard weight thickness beveled for welding are available for faster and stronger field welds.

Write for Bulletin No. 507 or call our distributors.

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Process Engineering: Standard Oil Development Co.; Construction Engineering: Brown and Root, Inc.

Creole Petroleum puts into service world's largest gas turbine installation

10 G-E UNITS DRIVE GAS COMPRESSORS FOR OIL-FIELD PRESSURE MAINTENANCE

The largest concentration of gas turbine horsepower in the world is now in continuous operation on a platform over Lake Maracaibo in Venezuela. There, seven miles from shore, ten General Electric gas turbines do a vital job for Creole Petroleum Corporation, driving centrifugal compressors which maintain gas pressure and thereby increase the yield from gigantic oil fields below.

CREOLE'S SUCCESSFUL INSTALLATION represents a new concept in oil-field pressure maintenance. The combination of centrifugal compressors and combustion gas turbines is designed to return 137,000,000 cubic feet of gas per day to the field at a pressure of 1935 pounds per square inch.

Naturally, reliability was an important reason for the selection of G-E gas turbines. Their light weight simplified the construction of the platform and its pilings.

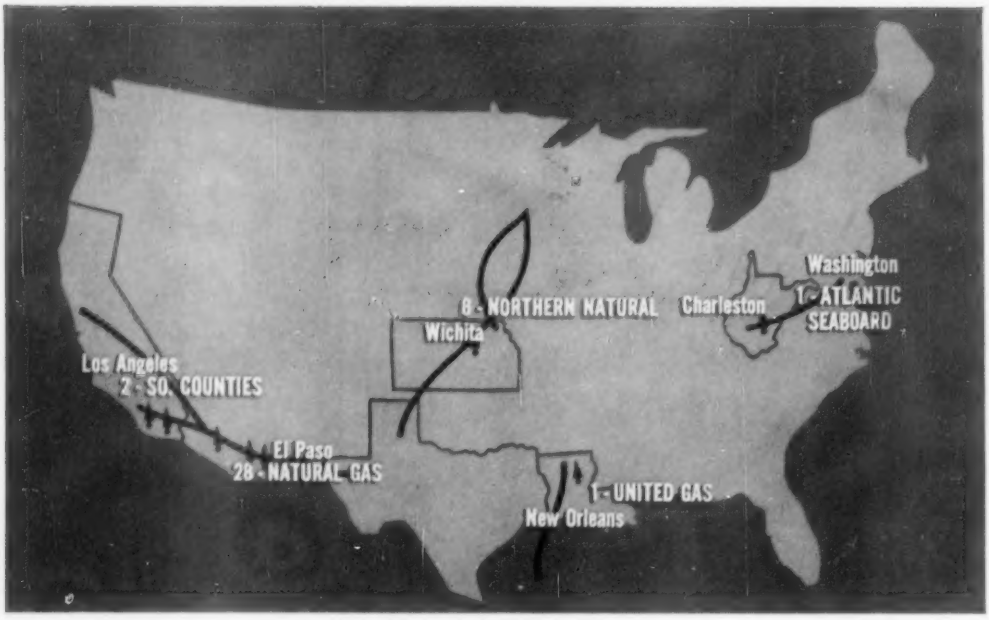
This remarkable installation is an outstanding example of petroleum industry enterprise and an important milestone in the progress of the gas turbine—industry's most important new prime mover.

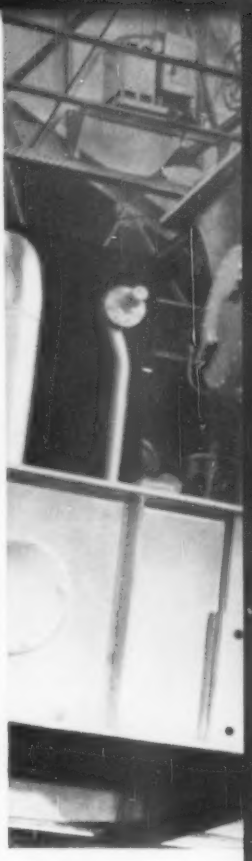
This is another example of the versatility of the G-E gas turbine. Turn to the next page for a progress report on the use of G-E gas turbines in natural gas pipeline stations. To date, these gas turbines have logged more than 310,000 operating hours in this service.

SEE GAS TURBINES FOR GAS PIPELINES

Progress Is Our Most Important Product

GENERAL ELECTRIC





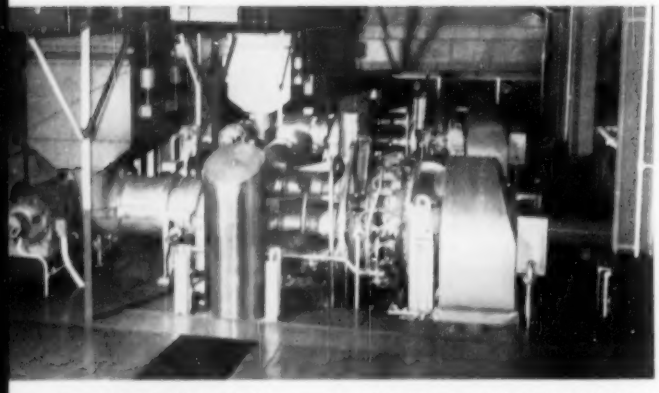
Installed throughout country . . .

40 G-E gas turbines

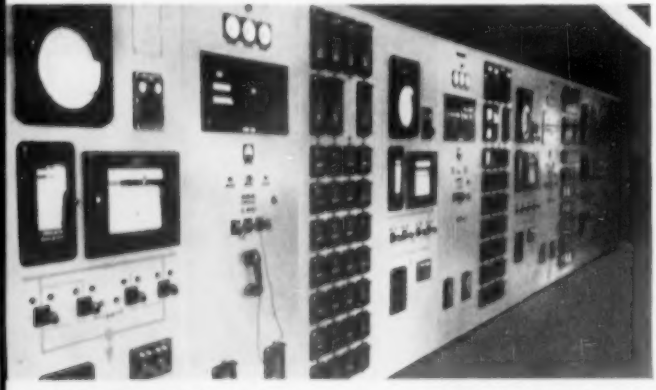
The 40 General Electric gas turbines in natural gas pipeline service throughout the United States have proved to be reliable, economical sources of power. Here are operating reports from installations on some of the country's outstanding natural gas pipelines:

EL PASO NATURAL GAS: The performance of 28 G-E gas turbines on this system has far exceeded expectations. They have operated for over 280,000 hours with a minimum of operating expense.

NORTHERN NATURAL: At this system's Tescott and Macksville, Kansas stations, eight G-E gas turbines are providing 25% more horsepower in the winter when gas demands are at a peak.



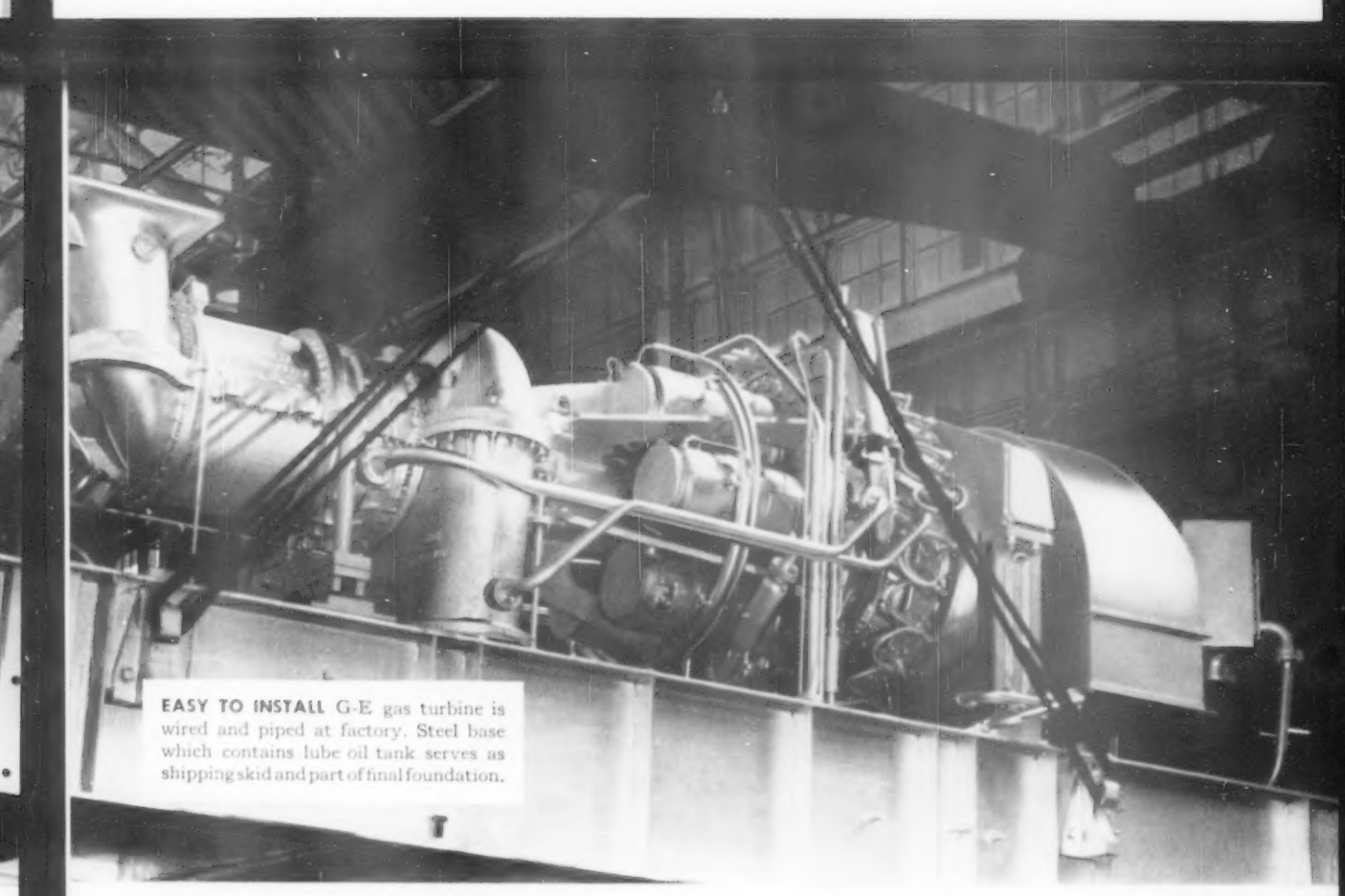
EL PASO Natural Gas reports 28 G-E gas turbines have helped to reduce system operating costs.



NORTHERN Natural Gas utilizes compact G-E control equipment for semi-automatic control of gas turbines.

ATLANTIC Seaboard has custom-engineered G-E Cabinetrol* unit for auxiliary control.

*Reg. Trademark G-E Co.



EASY TO INSTALL G-E gas turbine is wired and piped at factory. Steel base which contains lube oil tank serves as shipping skid and part of final foundation.

provide reliable, economical service for gas pipelines

ATLANTIC SEABOARD: The flexibility of the G-E gas turbine is illustrated at this system's Seneca station as a 5000-hp unit helps Atlantic Seaboard successfully meet widely varying load demands.

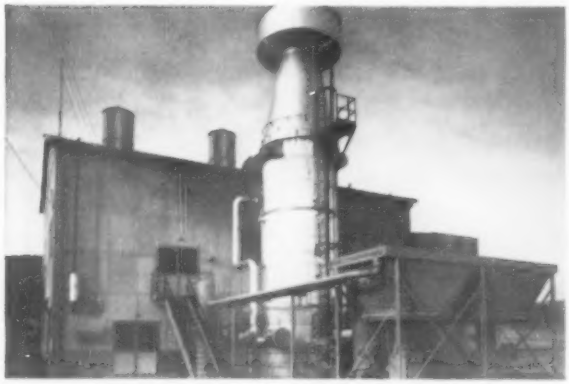
SOUTHERN COUNTIES AND SOUTHERN CALIFORNIA GAS COMPANIES: This system with two G-E gas turbines, reports installations at Desert Center and Cactus City, Calif. have proved "very satisfactory."

UNITED GAS: In first use in initial mainline station, a G-E gas turbine at Napoleonville, La. helped United Gas reach an all-time system peak delivery of more than 4 billion cfd.

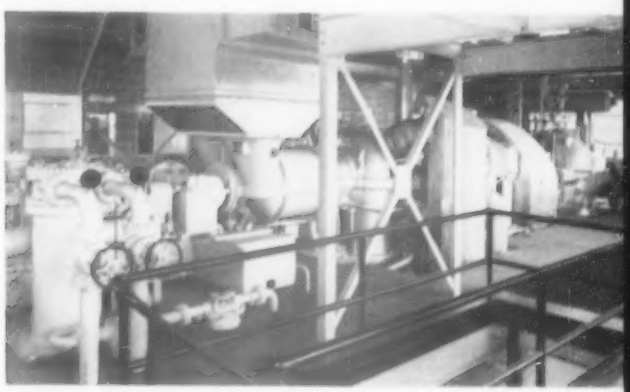
Follow the example of these 5 natural gas pipeline companies and install General Electric gas turbines on your pipeline system. For further information about G-E 6700-hp gas turbines, contact your nearest G-E Apparatus Sales Representative, or write for bulletin GEA-5962, Section 661-50, General Electric Company, Schenectady 5, N. Y.

Combustion Gas Turbines for the Gas Pipeline Industry—Backed by over 50 years of Turbine Leadership

GENERAL ELECTRIC



SOUTHERN Counties and Southern California Gas companies' regenerator increases efficiency.

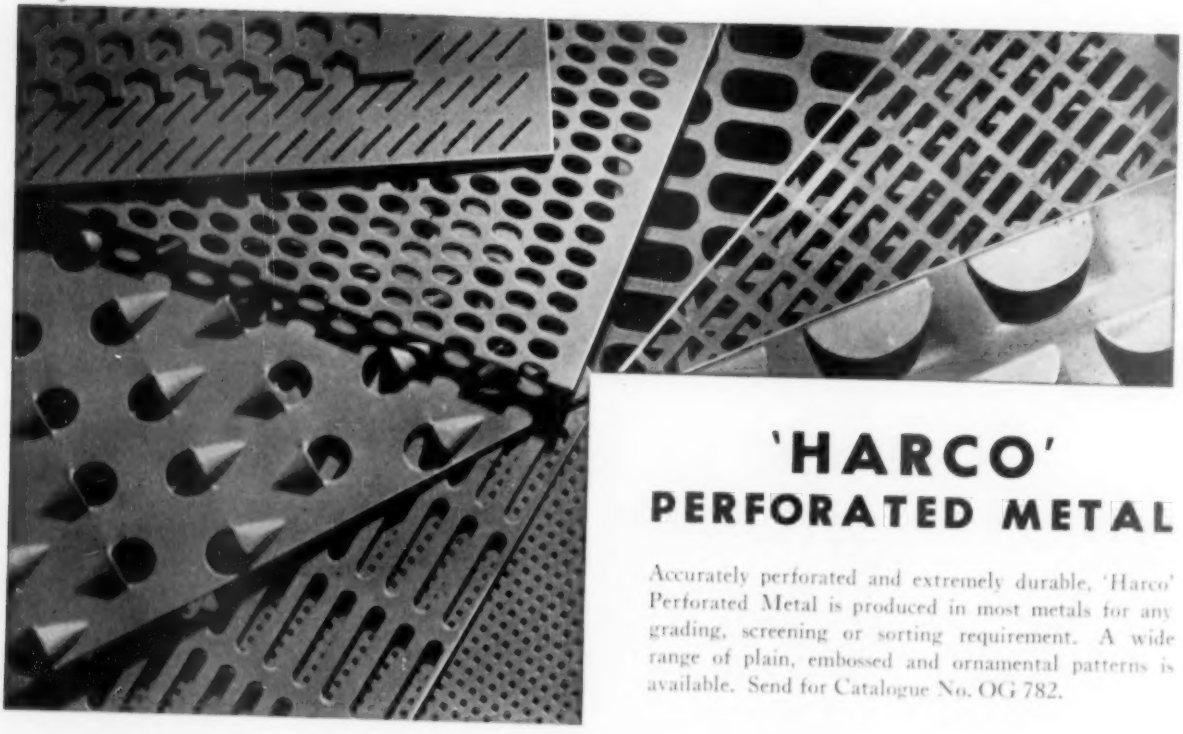


UNITED Gas says G-E gas turbine installation at Napoleonville, La. has proved its reliability.

'HARCO' WOVEN WIRE

Manufactured in a wide variety of metals, 'Harco' Woven Wire can be supplied in a gauge and mesh suitable for use in the processing of any material, from heavy minerals to fine powders and liquids.

Enquiries are invited. Send for Catalogue No. OG 858.



'HARCO' PERFORATED METAL

Accurately perforated and extremely durable, 'Harco' Perforated Metal is produced in most metals for any grading, screening or sorting requirement. A wide range of plain, embossed and ornamental patterns is available. Send for Catalogue No. OG 782.

Harvey

Cables: 'Cheaper, London.'

G. A. HARVEY & CO. (LONDON) LTD., WOOLWICH ROAD, LONDON, S.E.7, ENGLAND

Applying long-term pipeline protection

Quickly and Easily

Wrapping 8" and 10" Lake Country Gas Company natural gas line with Trantex Tape using Tapester wrapping machine. Line will serve the outlying commuter area of Cleveland. Trantex was used primarily because soil was extremely corrosive. Line was several miles in length.

J-M Trantex Tape is cold-applied, sticks on contact, bonds to enamel

Trantex® is recommended for

- Gas distribution systems
- Pipe lines through difficult terrain
- Field joints of mill-coated and wrapped pipe
- Transmission pipe lines
- Overhead piping

For further information, write to Johns-Manville, Box 60, New York 16, N. Y.; in Canada, 565 Lakeshore Road East, Port Credit, Ontario.

Wherever pipe lines require a long-lasting, corrosion-defying protective material . . . and easy, quick application is important . . . Trantex Tape is ideal. This pipe line coating can be applied by hand or with simple wrapping devices. No need for heavy-duty equipment or trained personnel. Trantex Tape sticks on contact, forms a firm, stable bond on either pipe or enamel . . . conforms to irregular surfaces.

In addition to on-the-job application, Trantex Tape is widely used on field-welded joints of mill-wrapped pipe to provide corrosion protection at these critical points.

Johns-Manville TRANTEX *polyvinyl* TAPE

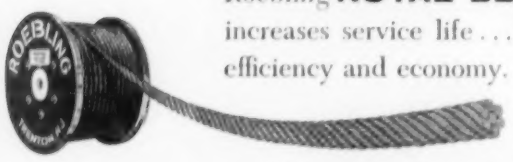
PROTECTS PIPELINES AGAINST CORROSION

NOW! SLASH WIRE ROPE COSTS WITH ROEBLING'S NEW

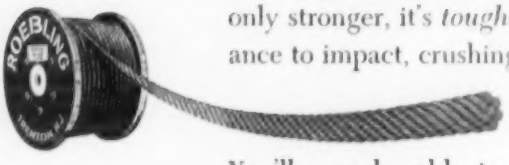
Royal 1105 Blue

15% STRONGER THAN YESTERDAY'S STANDARD

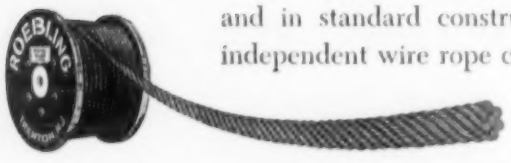
MADE OF ROEBLING'S NEW TYPE 1105 WIRE—the finest rope wire—Roebling **ROYAL BLUE** Wire Rope is guaranteed to be 15% stronger than standard wire ropes of the same size and construction.



Roebling **ROYAL BLUE** Wire Rope vastly increases service life . . . brings unprecedented efficiency and economy.



Roebling **ROYAL BLUE** Wire Rope is not only stronger, it's *tougher,* too . . . has top resistance to impact, crushing, abrasion and fatigue.



You'll soon be able to get **ROYAL BLUE** Wire Rope in all diameters from ¼" to 3½" and in standard constructions employing an independent wire rope core.

Get the whole story on Roebling **ROYAL BLUE**—the most important wire rope development in a score of years. Write us, or contact your distributor or nearest Roebling branch office.

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tt
TUBE-TURN

Remember the trademarks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS.

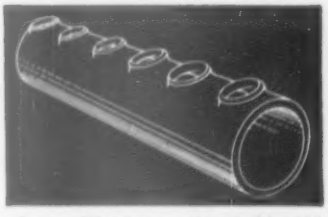
NEW!
TUBE-TURN Manifold Welding Fitting

simplifies piping construction, reduces costs

TUBE TURNS now offers custom-made Manifold Welding Fittings with size, wall thickness, and number of outlets as required by your service conditions. These manifold fittings are available in all commercial metals and alloys.

Use of TUBE-TURN* Manifold Welding Fittings provides stronger and safer outlet connections than are possible when pads and saddles are employed. This new fitting makes possible greater economy and speed of construction in many types of service. It is particularly useful when outlets are smaller than one-half the run pipe diameter, when they are extremely close together, or when they must vary in size.

This new addition to Tube Turns' line enables you to "specify TUBE-TURN" for all your tee and manifold fitting requirements. For prompt, helpful service, get in touch with your Tube Turns' Distributor. You'll find one in every principal city.



The new TUBE-TURN Manifold Welding Fitting . . . superior to pad and saddle construction . . . easy to install . . . dependable in service.

TUBE-TURN Welding Fittings and Flanges are made in U.S.A.
They meet *all* U. S. piping code specifications

*"TUBE-TURN" and "tt" Reg. U.S. Pat. Off.

TUBE TURNS

LOUISVILLE 1, KENTUCKY

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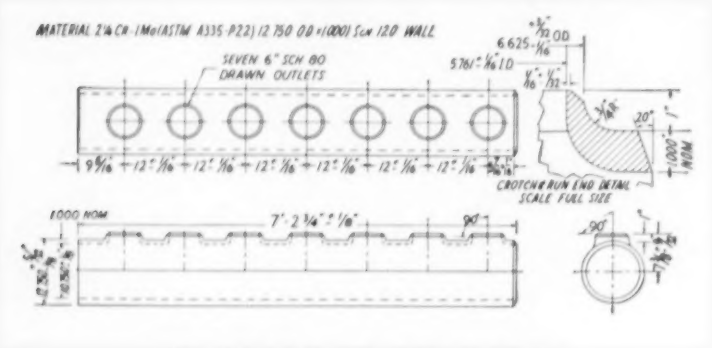
DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Cleveland • Detroit • Chicago • Denver • Los Angeles San Francisco • Seattle • Atlanta • Tulsa • Houston • Dallas • Midland, Texas

APPLICATIONS

Why TUBE-TURN Manifold Welding Fittings give you safer service

In conventional pad and saddle construction, the transition to the side section of the branch is abrupt, creating stress concentration, often leading to failure. The TUBE-TURN* Manifold Welding Fitting with *integral extruded outlets,* is superior in strength. It provides a smooth transition from the pipe run to the smaller, thinner-walled outlets, and is thus better able to withstand cyclic stress from pressure or temperature changes.

TUBE-TURN Manifold Welding Fitting being installed in a measuring station of a large west coast gas utility.



12" Manifold with Seven 6" Outlets. Schedule 80.

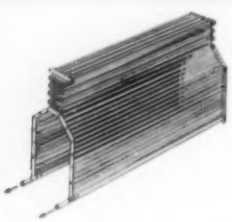
CODE APPROVED

TUBE-TURN Manifold Welding Fittings are in full accordance with the latest recommendations of ASA B31.1 Subcommittee No. 8.

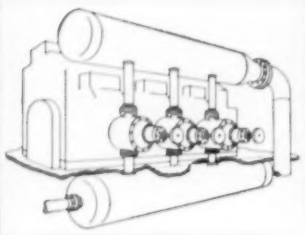
TUBE-TURN Manifold Welding Fittings comply with the requirements of ASA B16.9 and ASTM A234 covering the design and manufacture of butt welding fittings.

TYPICAL APPLICATIONS

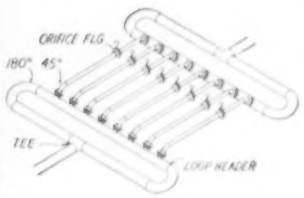
TUBE-TURN Manifold Welding Fittings can be used in virtually all types of major piping systems. Tube Turns' Sales Development Department will be glad to assist you in application problems.



Pipe Still or Charge Heater



Compressor Station Suction and Discharge Headers



Meter Run Loop Header

MANIFOLD DATA

Send for bulletin covering Manifold Welding Fitting Applications. Just mail the coupon.

TUBE TURNS, Dept. J-3
224 East Broadway, Louisville 1, Kentucky

Please send bulletin on new Manifold Welding Fittings.

Company Name _____

Company Address _____

City _____ *Zone* ____ *State* _____

Your Name _____

Position _____

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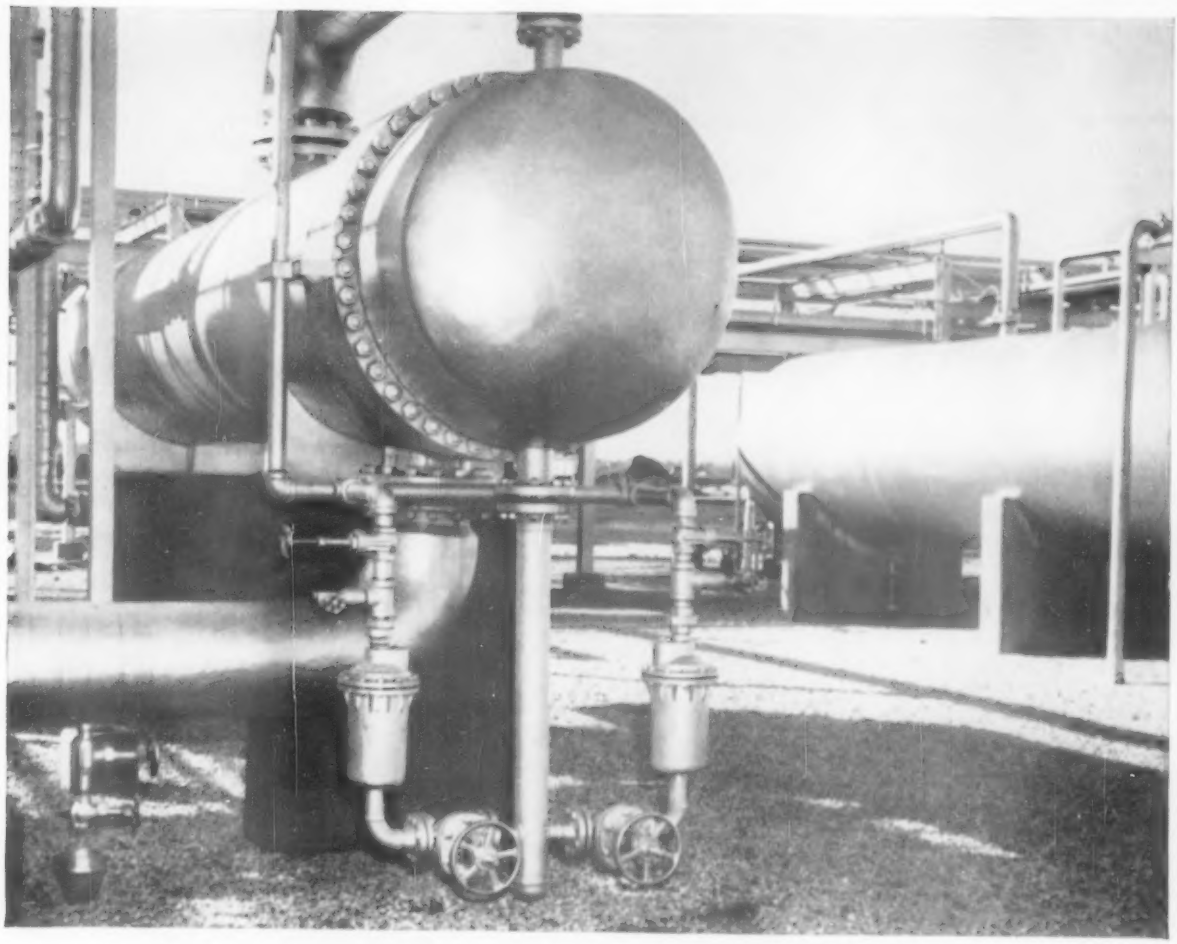
*"TUBE-TURN" and "tt" Reg. U.S. Pat. Off.

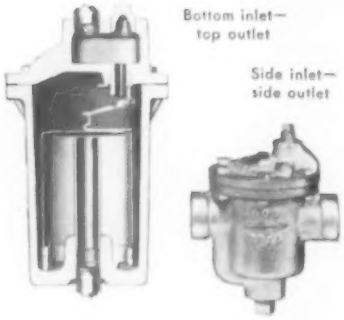
TUBE TURNS

A DIVISION OF NATIONAL CYLINDER GAS COMPANY

LOUISVILLE 1, KENTUCKY



A Look at Low Cost Maintenance . . .



Corrosion- and wear-resistant materials; "frictionless" leverage; precision workmanship — add up to LOW MAINTENANCE.

JUST a couple of steam traps stuck out in a cycling plant, along with a lot of valves and piping . . . that's what the picture shows. What the picture doesn't show is the big reason for the choice of those two Armstrong traps: *low cost maintenance.*

There is a tremendous investment in capital equipment riding on the performance of such small auxiliaries as steam traps. They have to work right 24 hours a day. Troublesome traps can eat up maintenance time like the desert can soak up water. That's why a photographer could work 'til doomsday without getting pictures of all the Armstrong traps in petroleum plants around the world. They've proved themselves on the maintenance score!

Only two moving parts . . . no sliding fits, no fixed pivots . . . file-hard chrome steel valve and seat . . . corrosion-resistant stainless mechanism . . . heavy reinforcement of wearing parts . . . generous safety margins . . . precision workmanship . . . factory testing of every trap — these are the things that pay off in long, long service life with infrequent maintenance. Ask your Armstrong Representative to show you the technical fine points that make such a big difference. Or, write:

ARMSTRONG MACHINE WORKS
868 Maple Street • Three Rivers, Michigan

Application Engineered

ARMSTRONG STEAM TRAPS

THE STEAM TRAP BOOK . . .
Tells more about traps and trapping—44-pages of useful data free on request.

585

FULL LINE OF STEEL PLATES If you are in the market for sheared or universal plates, you can count on Bethlehem meeting your requirements. We produce these types in a complete range of sizes: Alloy, Flange, Structural, Firebox, Forging, Medium-Manganese, Mayari R (low-alloy, high-tensile), Abrasive-Resisting and Marine. For additional information, please get in touch with the Bethlehem sales office nearest you.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

No wonder
AUTOCAR TRUCKS
Last and Last!

YOU GET *more* work out of an Autocar . . . for longer . . . because there's a lot more going into an Autocar than other trucks.

More of the things that count! Like custom engineering that you get only when you buy a truck tailored to your own business needs. And precision workmanship by the truck-building craftsmen at Autocar's modern, new plant.

Finest of materials, too! Like the frames made of high quality, heat-treated alloy steel rails.

Feature for feature, you get the best in Autocar . . . the best of them all to do the most work on the big jobs, year after year.

CHECK THE FRAMES AND YOU'LL PICK AUTOCAR!

The "Pros" of the trucking industry know that the truck frame has to be right for the big jobs—the heavy loads—that torture ordinary trucks. Autocar frames, made of heat-treated alloy steel rails flex and spring under stress.

Ordinary cold-rolled carbon steel frames used in most trucks can't stand shock and hard wear. Permanent deflection results in misalignment of major units, vibration, and rapid deterioration.

Autocar frames are rigid enough to hold truck units in position . . . flexible enough to stand rough going. No stress or strain.

GET YOUR COPY OF THE NEW AUTOCAR FACT BOOK NOW!

AUTOCAR TRUCKS

AUTOCAR DIVISION OF THE WHITE MOTOR COMPANY
EXTON, PA.

Autocar Division of The White Motor Company, Exton, Pennsylvania

☐ Please send me a free copy of the Autocar Fact Book
☐ Send me copy of 1955 Autocar Cost Record Book

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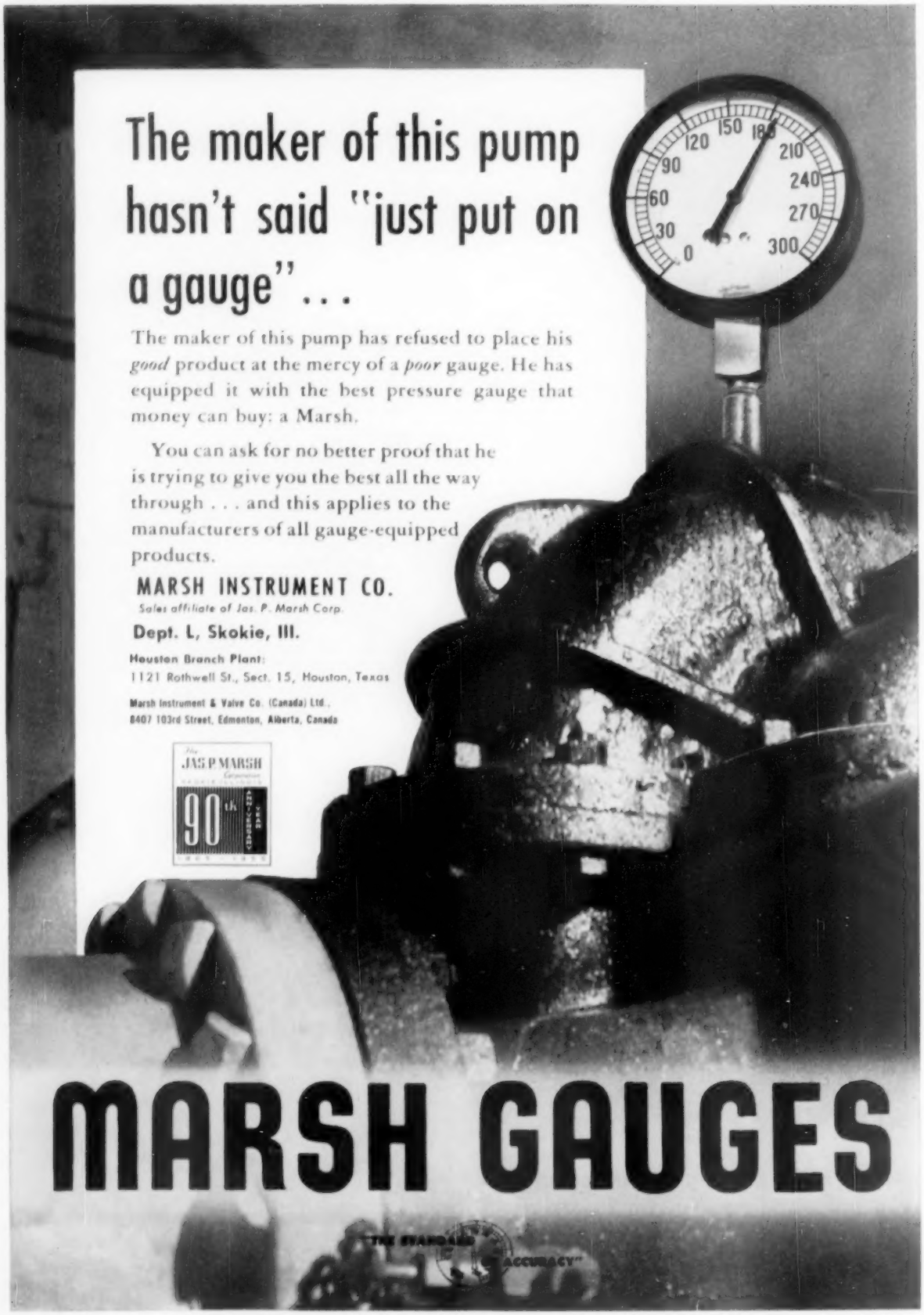
The maker of this pump hasn't said "just put on a gauge"...
The maker of this pump has refused to place his *good* product at the mercy of a *poor* gauge. He has equipped it with the best pressure gauge that money can buy: a Marsh.
You can ask for no better proof that he is trying to give you the best all the way through . . . and this applies to the manufacturers of all gauge-equipped products.
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8407 103rd Street, Edmonton, Alberta, Canada
JAS P MARSH
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MARSH GAUGES
"THE STANDARD OF ACCURACY"

for MODERN refineries

TWO NEW *unitized* VACUUM TANKS

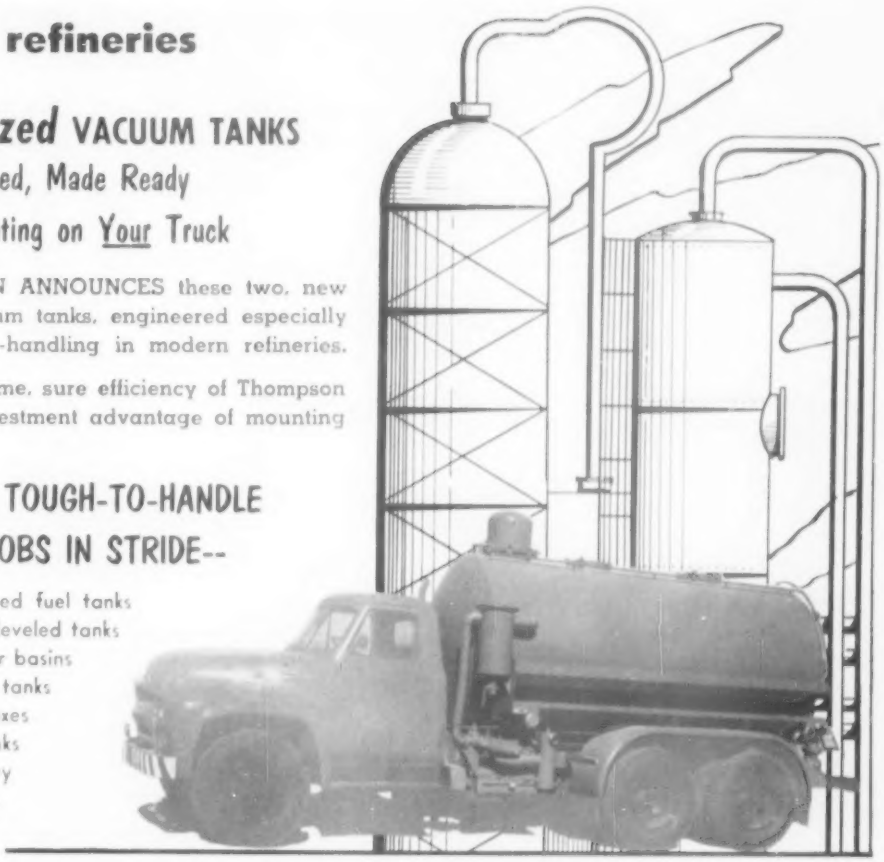
Self-contained, Made Ready for Your Mounting on Your Truck

NOW! THOMPSON ANNOUNCES these two, new ready-to-mount vacuum tanks, engineered especially for modern materials-handling in modern refineries.

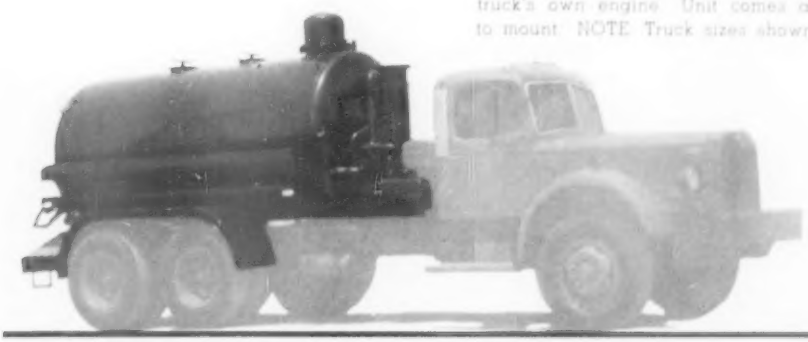
They give you the same, sure efficiency of Thompson UVT plus the low-investment advantage of mounting on your own truck.

TAKES THESE TOUGH-TO-HANDLE REFINERY JOBS IN STRIDE--

Coil-cleaning in cracked fuel tanks
Cleaning caustic and leveled tanks
Cleaning cooling tower basins
Cleaning wax out of tanks
Cleaning separator boxes
Cleaning run-down tanks
Handling catalyst slurry
Unplugging drain lines
Cleaning drain boxes
Cleaning crude tanks



Model ST is available in 7 sizes. The 30, 35, and 40 bbl. units fit a 2-axle truck with 153" wheelbase and 84" CA; the 45, 50, 55, and 60 bbl. sizes fit a 3-axle truck with 175" wheelbase and 102" CA. (55 and 60 bbl. units are for off-highway use.) Power-pump take-off is from truck's own engine. Unit comes as 4-pc. kit, takes less than a day to mount. NOTE: Truck sizes shown are approximate.



Model WT comes in 40, 45 or 50 bbl. capacities. Mounts on truck with 193" wheelbase, 120" CA. Has own gasoline engine and pump. One-piece unit takes less than half-a-day to mount. NOTE: Truck size shown is approximate.

SOLE LICENSEE TO MANUFACTURE VACUUM TANKS UNDER U. S. PAT. NO. 2522077

THOMPSON
Tank & Manufacturing Co., Inc.
2019 East Wardlow Road, Long Beach 7, California

WRITE FOR SPECIFICATIONS

Complete with blueprinted mounting instructions furnished. If you'd like to see Thompson UVT's at work, we'll tell you where, in your area, you can watch them save time and money — pay for themselves time and again. Write today!

This is Why the Nash is the Most Simple Compressor

It's the Nash!

There are no mechanical complications in a Nash Compressor. A single moving element, a round rotor, with shrouded blades, forming a series of buckets, revolves freely in an elliptical casing containing any low viscosity liquid. This liquid, carried with the rotor, follows the elliptical contour of the casing.

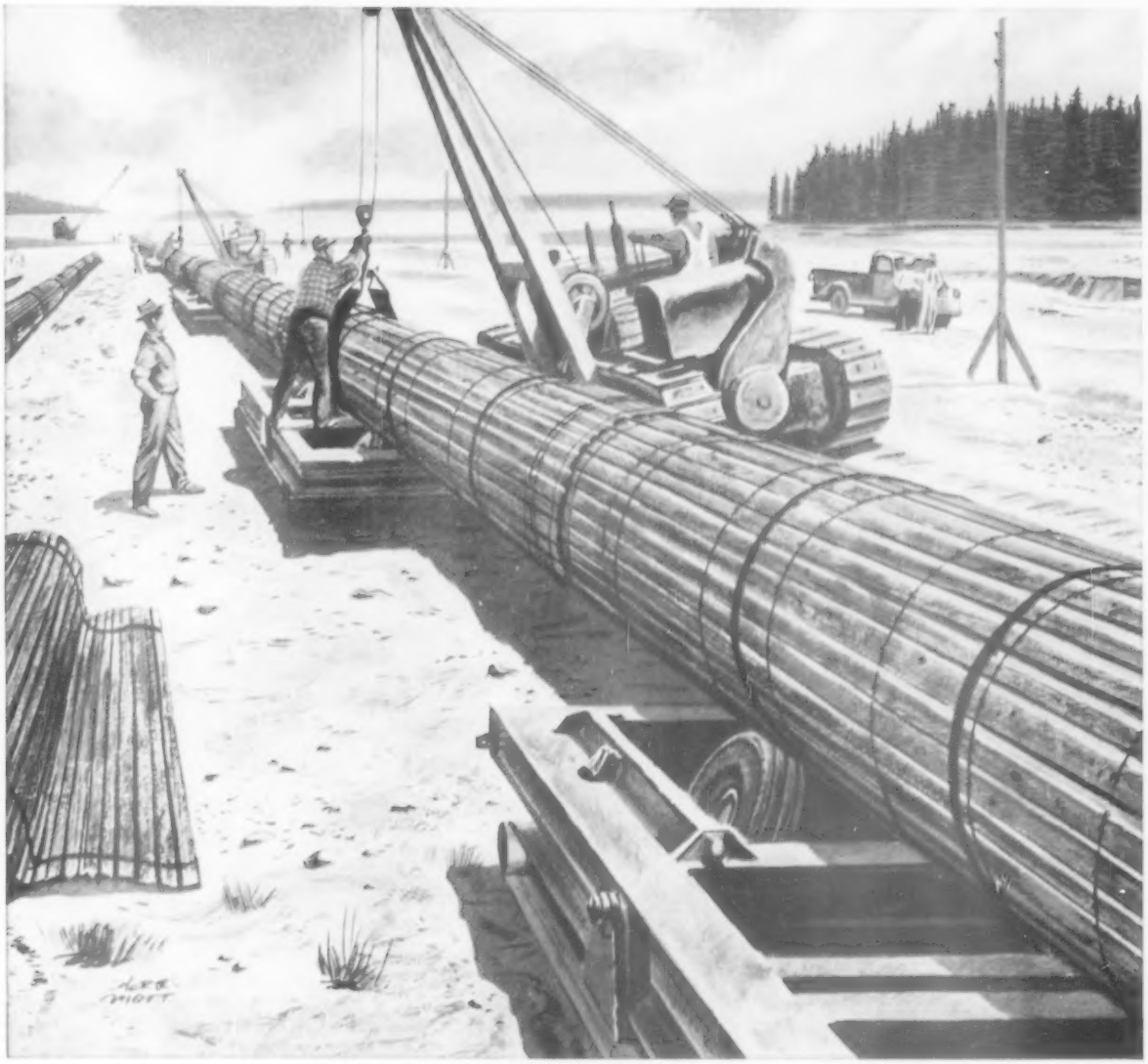
The moving liquid therefore recedes from the rotor buckets at the wide part of the ellipse, permitting the buckets to fill with gas from the stationary Inlet Ports. As the casing narrows, the liquid is forced back into the rotor buckets, compressing the gas, and delivering it through the fixed Outlet Ports.

Nash Compressors produce 75 lbs pressure in a single stage, with capacities to 6 million cu. ft. per day in a single structure. Since compression is secured by an entirely different principle, gas pumping problems difficult with ordinary pumps are often handled easily in a Nash.

Nash simplicity means low maintenance cost, with original pump performance constant over long periods. Data on these pumps sent immediately on request

- No internal wearing parts.
- No valves, pistons, or vanes.
- No internal lubrication.
- Low maintenance cost.
- Saves floor space.
- Desired delivery temperature automatically maintained.
- Slugs of liquid entering pump will do no harm.
- 75 pounds in a single stage.

NASH ENGINEERING COMPANY
313 WILSON, SO. NORWALK, CONN.



"All set for the big pull"

This 2500 ft. section of 30" pipe is about to be winched across the Straits of Mackinac. A special wheeled launching ways had to be constructed for this job, the longest and deepest underwater crossing ever made by a major pipeline. The scene above shows the first section ready to go with hardwood strips attached to the outside of the pipe as added protection against the rough, rocky bottom of the straits.

Underneath the wooden strips the entire length of this pipeline has been coated with Barrett primer and coal-tar enamel. Wet, rocky lake bottom or dry, sandy desert . . . it's all the same to Barrett Protective Coatings . . . they prolong the life of the pipe indefinitely, yet represent only a small fraction of the total cost. That's why the "Lakehead Line" like so many other tough jobs used Barrett Coatings exclusively.

And when you specify Barrett, you get not only the finest protective coatings but the best application "know how" available. The Barrett Technical Service Group provide expert assistance right from the planning stage in the selection of the right wrapping and coating for your job. In the field, Barrett Service Representatives are always ready to provide advice and assistance in the application of coating materials.

We welcome the opportunity to place the Barrett Technical Service Group at *your* service. For detailed information—phone, write or wire Barrett.

BARRETT DIVISION, Allied Chemical & Dye Corporation, 40 Rector Street, New York 6, N. Y. In Canada: The Barrett Company, Ltd., 5551 St. Hubert St., Montreal, Que.

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BARRETT PROTECTIVE COATINGS

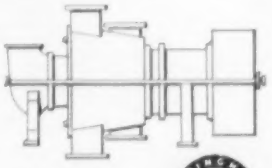
OVER 100 YEARS OF EXPERIENCE

FACTS on Westinghouse 5000-hp gas turbines . . .

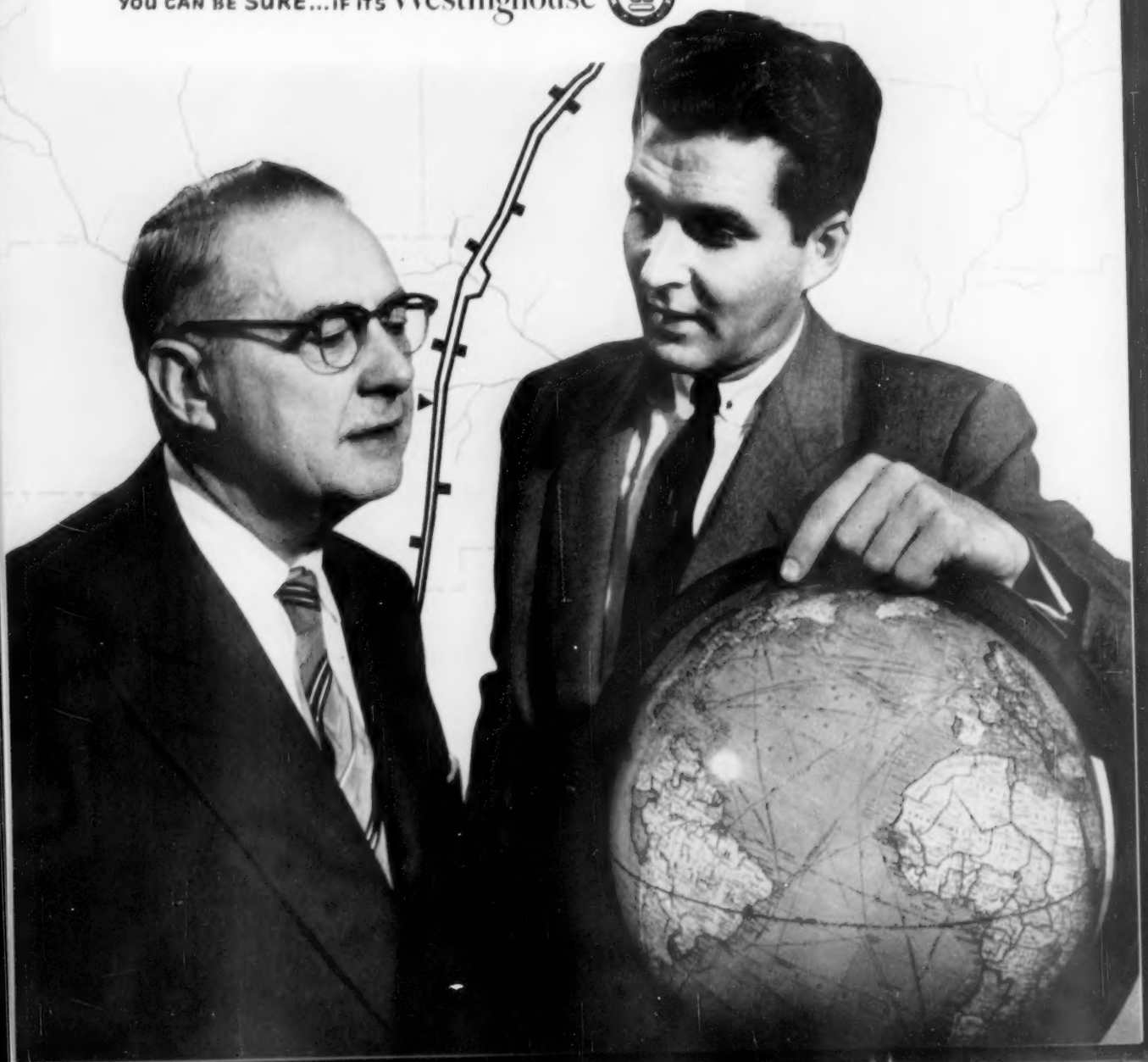
Backed by world-wide service

Wherever in the world a pipeline begins, goes or ends, there's a Westinghouse field engineer available to render competent engineering service. • This is based on 60 years' Westinghouse pipeline experience. • Field engineers are backed up by headquarters specialists who stand ready to visit locations anywhere and make detailed studies. • Every Westinghouse gas turbine carries with it this extra assurance of complete satisfaction.

For more information, see your Westinghouse sales engineer, THE MAN WITH THE FACTS, or write for booklet B-5859. Westinghouse Electric Corporation, 3 Gateway Center, Pittsburgh 30, Pa. J-50586



YOU CAN BE SURE... IF IT'S Westinghouse



Look to COOK for Better VALVE PLATES!

Really
Superior
Valve
Plates are another outstanding product of the C. Lee Cook Company.

Notice that the slots are milled, and that the surface is ground. Look at the *square, smooth edges* — made possible by the excellent machining qualities of the phenolic-resin surface sheets. Inspect the edges carefully under the magnifying glass and you'll see that they're absolutely free of any *cracks, crevices or crazing to cause erosion!*

The cross-section, right, shows the surface sheets of pure cotton fabric, possessing finest machining qualities. Note the strong core, too — *it's designed to withstand constant flexing!*

R.S.V.P.!—use the coupon for more information about Cook's *Really Superior Valve Plates!*

C. LEE COOK COMPANY

Sealing Pressures Since 1888

C. Lee Cook Company
972 South Eighth Street
Louisville 3, Kentucky

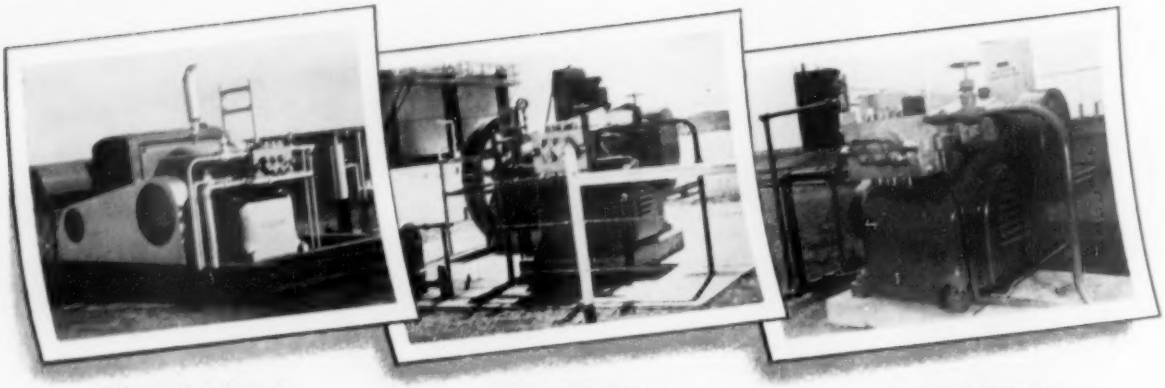
Gentlemen: Without obligation, please send me complete information about Cook valve plates.

Company_____

Street_____

City_____ State_____

Att. Mr._____ Title_____



It's a GAULIN
with multiple-cylinder gasoline engine! Can be either belt driven or direct connected.

It's a GAULIN
with one-cylinder gasoline engine!

It's a GAULIN
with electric motors integral in unit!

...wherever you see them GAULIN TRIPLEX PUMPS keep on working!

Surface Power Units for Subsurface Hydraulic Pumping

These Gaulin features have been developed especially to meet the requirements of the oil industry.

HORIZONTAL DESIGN
of power unit completely separates cylinder from crankcase, preventing any product leakage to crankcase. Cylinder assembly may be taken apart in minutes. Just lift cover and all parts instantly accessible for inspection or repair.

PLEXIGLAS WELL COVERS
give instant visual check of plunger and packing condition.

CORROSION-PROOF CYLINDERS
are made of stainless. Hardened stainless or ceramic plungers available.

SPRING-LOADED PLUNGER
packing is self-adjusting, self-sealing, eliminates the human element.

API BALL VALVES
and removable seats permit easy replacement in the field.

WIDE CAPACITY AND PRESSURE
range easily, economically obtained by changing plunger size in the field.

MANUFACTURED BY:

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Manufacturing Co., Inc.
73 Garden St., Everett 49, Mass.

Gaulin TRADE MARK

***Call:* Specialty Sales & Service, Inc.**
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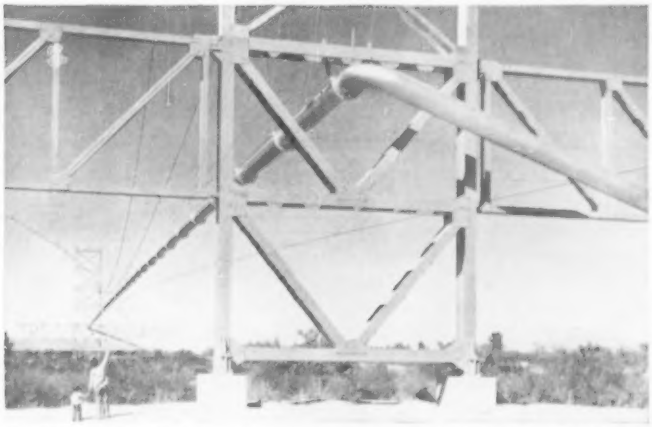
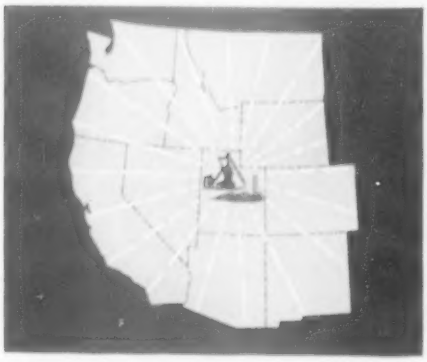
MANTON-GAULIN MANUFACTURING CO., INC., La Habra, California
M. Les Walraven, Mgr. Oil Field Sales (Oxford 7-6334) (Long Beach 4-1596)

FROM NEW "HUB OF THE WEST" SOURCE...

USS QUALITY PIPE KEEPS PACE WITH THE WEST



Consolidated Western's new plant serves the entire West with Gas and Oil Pipe



With the opening of its new Utah plant now under construction on a 117 acre site near Provo, Consolidated Western Steel has once again expanded its facilities to keep pace with the need for pipe to build the West's great projects... like this 1040 foot pipeline over the Colorado River. Built from high strength sections of 30" Consolidated Western welded steel pipe, the span is a key link joining the El Paso Natural Gas Line with the Southern California and Southern Counties Gas Systems.

Because United States Steel emphasizes quality control from mine to mill to finished steel... its high-quality steel pipe is in demand the world over. A major portion of the world's large-diameter welded steel gas and oil pipe has been produced by the Consolidated Western process. For 100 years, Consolidated Western Steel has pioneered the fabrication, erection and manufacture of pipe, structural steel, plate products and mechanical equipment—constantly proving that only steel can do so many jobs so well.

The new plant at Provo, Utah is ideally located to serve you with the greatest possible efficiency. It will produce and deliver the highest quality electric-welded steel pipe at the lowest possible cost. Sizes available include 4" to 40" diameters to meet the needs of transmission pipelines, distribution systems and industrial installations.

CONSOLIDATED WESTERN STEEL

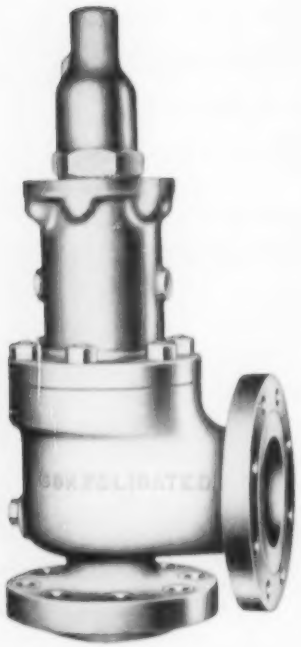
Sales Offices: Los Angeles, San Francisco, Fresno, Bakersfield, California; Phoenix, Arizona; Seattle, Washington; Houston, Texas

DIVISION

UNITED STATES STEEL

NOW...CONSOLIDATED SAFETY RELIEF VALVES in economical "2 in 1" design

Peak performance . . . positive valve action assured . . . even where discharge lines are long, or low "superimposed" back pressure exists in the relieving system.



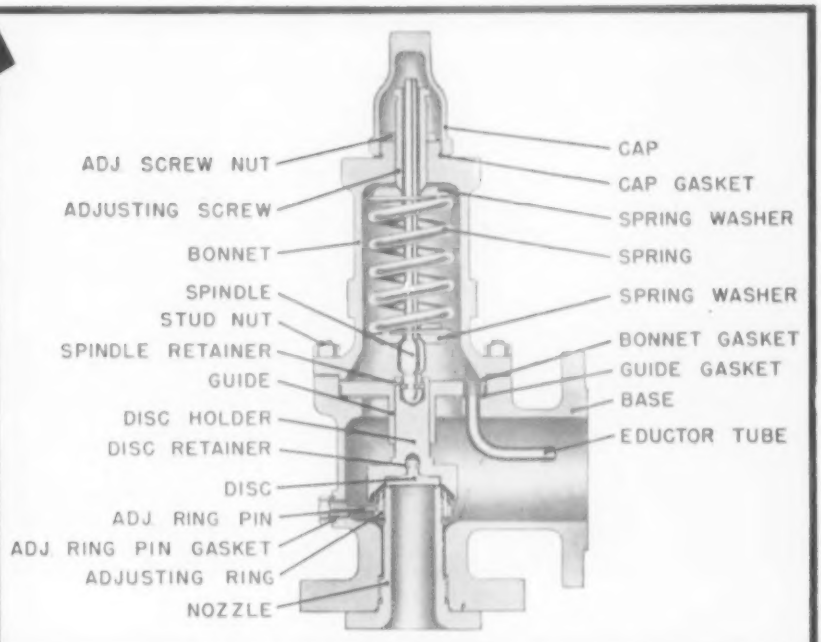
"Two-In-One" design, improved performance . . . the new Consolidated Safety Relief Valve is the result of over 4,000 flow tests in 5 years at West Edmond, Oklahoma. At the A.S.M.E.-approved testing station there, natural gas is available in flow capacities up to 35,000 cfm and pressures up to 500 psig. The A.S.M.E.-approved conditions, apparatus, and procedures permitted Consolidated engineers to test-develop and prove the full range of valve sizes and pressures in both Standard and Bellows designs.

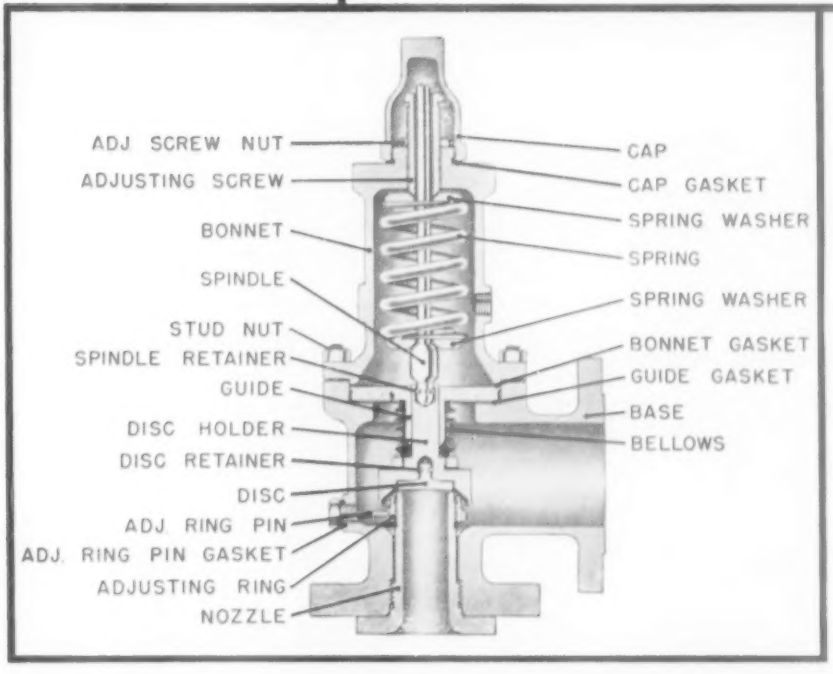
Interchangeability is so highly developed that the majority of Consolidated Standard Valves can be converted to the Bellows design, in the field, simply by installing the bellows. Each type has fewer functional parts than other comparable safety relief valves. Standardization of inlet and outlet center-to-face dimensions permits interchangeability with a large proportion of the valves of other manufacturers. Incorporated is an optically-ground flat seating surface that contributes to easier, more economical maintenance.

You can have the absolute protection and real economy of the thoroughly tried and proved Consolidated Safety Relief Valves for your plant today. Both Standard and Bellows types are available in sizes and pressures to meet requirements of the most advanced processing facilities. Write for full details. Ask for Catalog 1900.

CONSOLIDATED SAFETY RELIEF VALVES

STANDARD VALVE has an eductor tube that holds the pressure in the valve bonnet to approximately atmospheric pressure; thus only the force of the spring controls the valve. Valve action is improved and stabilized . . . repetitive flow capacity is provided . . . a new high in operational dependability is assured. Even under repeated popping of the valve, set pressure and blowdown are consistent. The valve will open to full capacity at 3% overpressure regardless of the position of the adjusting ring.





BELLOWS VALVE is like the Standard but has a durable, two-ply stainless steel sealing bellows which effectively isolates from the valve's working parts any contaminants, corrosion, or viscous fluids. The bellows is balanced with the seating surface: set pressure of the valve is not affected by back pressure, whether constant or variable. Consequently, smaller discharge piping can be used, thus reducing the cost of pressure-relieving systems.

Certified and Approved

Both Standard and Bellows Valves are approved under A.P.I.-A.S.M.E. Unfired Pressure Vessel Codes, A.S.M.E. Unfired Pressure Vessel Code and are certified by the National Board of Boiler and Pressure Vessel Inspectors.

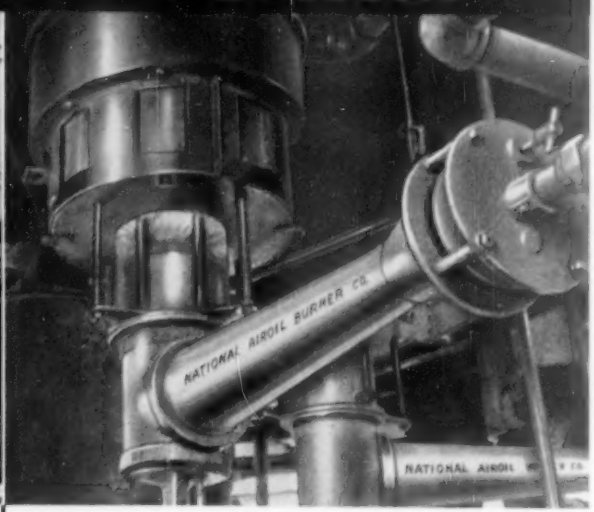
CONSOLIDATED 1879 U.S.A.

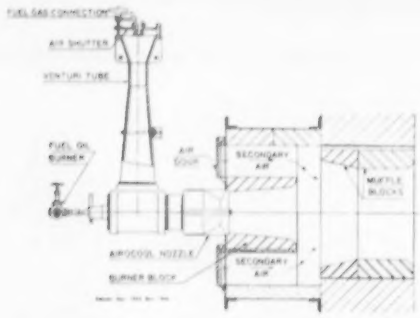
A PRODUCT OF MANNING, MAXWELL & MOORE, INC.

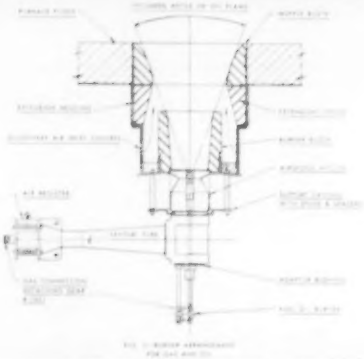
TULSA, OKLAHOMA

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* 'SHAW BOX' AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

horizontal or vertical







many more hours on stream, without forced shutdown with National Airoil Oil-Gas tandem combustion units

Exclusively for vertical firing, the new National Airoil VERTICAL Tandem Block Units retain all the features of our regular horizontal Tandem Units . . . *plus:* special, pre-cast refractory shapes for easier, cost-saving vertical installation and maintenance; secondary air inlet louvres for positive control of vertical flame pattern; and, all steel duplex detaching gear which enables simple vertical burner change over.

VERTICAL and HORIZONTAL Tandem Units hold air in the combustion zone until fuel and heated air are thoroughly mixed. This means that ignition takes place in a hot zone; the result: high fuel economy through more rapid combustion with a minimum of excess air. NATIONAL AIROIL's patented Tandem Combustion Units allow secondary air to be easily and accurately controlled. By adjusting air control louvres, flame can be shaped to radiate heat uniformly without tube impingement.

The VERTICAL or HORIZONTAL Tandem Unit is always fired with NATIONAL AIROIL Combination Oil and Gas Burners . . . has a high turndown ratio with a steady flame temperature using either fuel oil or gas. With the TANDEM UNIT's clean flame, a cold furnace can be brought to full capacity in a short time.

"Many, many more hours on stream, without shutdown" . . . yes, YOU will realize higher profits from YOUR heaters when NATIONAL AIROIL VERTICAL or HORIZONTAL Tandem Units are specified. Our new Bulletin 498 is yours for the asking.

CHEMICAL-PETROLEUM DIVISION

NATIONAL AIROIL BURNER CO., INC.

Main Office & Factory: 1236 EAST SEDGLEY AVENUE, PHILADELPHIA 34, PA.
Southwestern Division: 2512 South Boulevard, Houston 6, Texas
INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

Mr. Design Engineer

Mr. Purchasing Director

Mr. Plant Superintendent

BROWN FINTUBE DESIGN PROTECTS YOU AGAINST

YOUR *Occupational Hazard*

● If it hasn't happened to you yet,—it will. Beware!

Some day the company is going to decide to make a new product at your plant. The "market analysis and research" department will assure you the maximum requirement is so many thousand gallons a week. You'll design the plant . . . buy the equipment . . . get on stream . . . and then two or three months later — BOOM!

The market analysis boys "played it safe". Now — based on "newly available statistics" — they need 20% to 30% more output than the plant you just finished can possibly produce.

If you equipped that plant with "bundle" type exchangers you are going to have to wait, while you design — and fabricate — and install all new units. *And,* what are you going to do with the exchangers you just bought? Throw them away after only two or three months use?

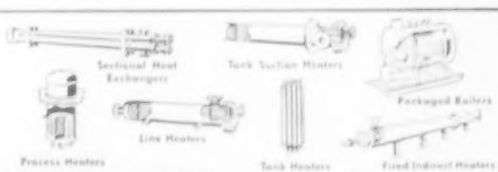
If you had used Brown Fintube Heat Exchanger **Sections** in that plant you would need only to add a few sections or change the series-parallel manifolding. You would be running on the new duty,— or even an entirely different product — in just a few days — with a **minimum of new equipment** — and **nothing to throw away.**

That's what we call "**flexibility**". You can change from one duty to another any time you want. You can even dismantle an exchanger, ship the sections to one or three or four different plants, and put them right back in service again.

Many of the biggest, best known and lowest cost companies are keeping **flexible** by using Brown Fintube **Sections** throughout their plants. Why don't you play it safe too? Available with mild steel, stainless, alloy and non-ferrous fintubes — in standard sizes — for a wide range of capacities and pressures. Send for Bulletin No. 512. It gives full details. And plan on keeping your plant **flexible** with Brown Fintube **Sections.** They will really save you money!

BROWN FINTUBE CO.

365 HURON ST., *Elyria, Ohio*



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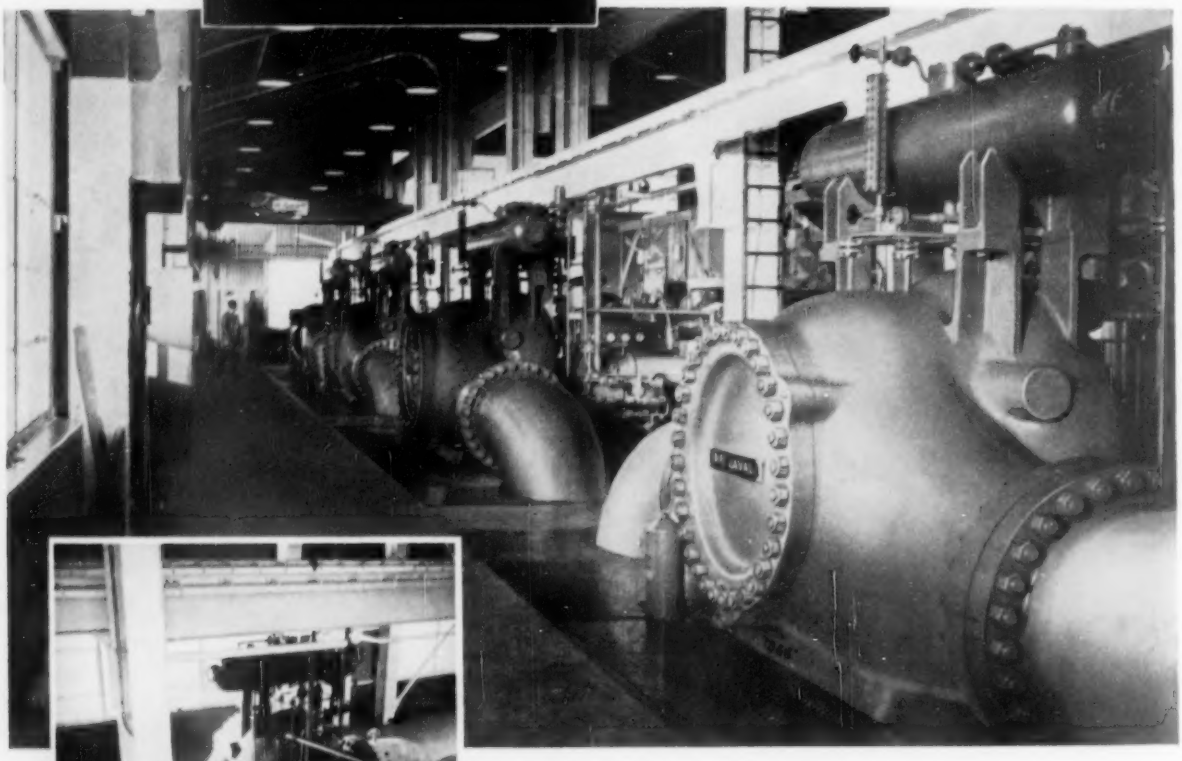
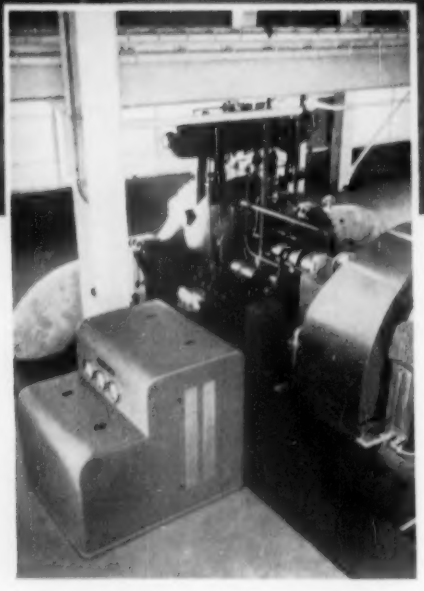
FOUR **DE LAVAL CENTRIFUGAL COMPRESSORS** *in Tescott, Kansas station of Northern Natural Gas*





For easy installation, De Laval pipeline compressors are designed in two packages: (1) The machine plus the emergency seal tank, (2) The auxiliary console which contains the filters, pumps, coolers and other accessories.

Here's more proof of the efficiency and dependability of De Laval centrifugal compressors for high pressure gas transmission. This Tescott, Kansas station of the Northern Natural Gas Co. has four De Laval centrifugal compressors in series.

The station flow is 930 M^2SCFD, station inlet pressure 477 psig and discharge pressure 745 psig. *By changing the impeller and a few minor parts, these units can handle 1,100 to 1,200 M^2SCFD.* Three identical De Laval compressors are on the job in the Macksville, Kansas station of Northern Natural.

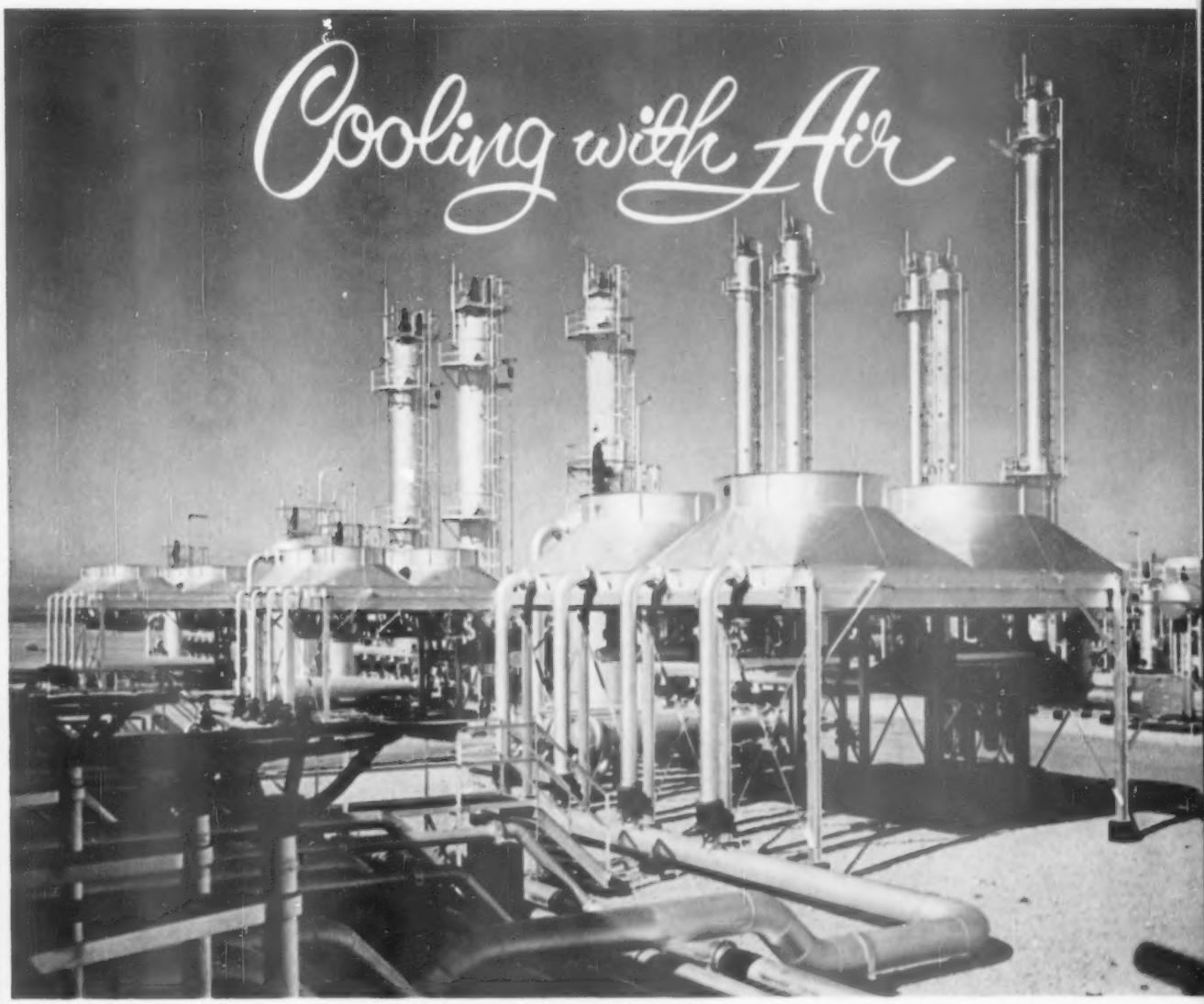
De Laval centrifugal compressors offer important engineering features. • Pressure contact shaft seal eliminates gas leakage. • Construction is heavy and rigid throughout. • Units have high load carrying capacity. De Laval units, totaling more than 200,000 hp, are now in operation on major pipelines.

DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY

810 Nottingham Way, Trenton 2, New Jersey

DLS-108



HUDSON **SOLO-AIRE** units as pictured above are employed for dissipation of heat directly to air in rapidly expanding diversification of services. Almost every modern chemical plant, gas processing plant, or oil refinery, has cooling problems for which engineering comparisons dictate the use of Solo-aires for one or more services.

In water-scarce locations the choice of Solo-aires is obvious. Even where water is plentiful, careful comparisons of capital expenditures for cooling tower, piping, valving, water pumps, hot fluid to water exchangers, and costs of water treating, power and maintenance may result in selection of Solo-aires for direct cooling with air.

Where summer ambient air temperatures are too high to effect the required cooling with direct use of air, the HUDSON **COMBIN-AIRE**, in which air is first pre-cooled during warm weather, allows the advantages of air cooling with none of the disadvantages of ordinary cooling towers. Combin-aires are now constructed of fireproof materials, and as water spray is completely eliminated, they may be installed adjacent to process equipment.

Before proceeding with final design of process plant cooling systems let HUDSON assist you in making completely objective comparisons of water versus air cooling for all services.

New

Air cooled equipment bulletin mailed upon request

HUDSON
ENGINEERING CORPORATION

FAIRVIEW STATION • HOUSTON, TEXAS

Accurate, Automatic Temperature Control

Hudson Solo-aire or Combin-aire units, or water cooling towers may be equipped with Auto-Variable pitch fans. Minute changes in cooled fluid outlet temperature immediately and automatically changes pitch of fan blades increasing or decreasing air flow. Control is effective despite changes in heat load or hot fluid inlet temperature; and over ambient air temperature range of more than 150° F.

Compared with fixed-pitch fans, Hudson Auto-Variable fans effect power *savings* of as much as 85%, depending upon actual versus design air temperatures.

Hundreds of auto-variable pitch fans from 6 to 18 feet in diameter are providing accurate, trouble-free, temperature control without necessity for shutters, louvers or by-passes, and with large power savings.

HUDSON AUTO-VARIABLE PITCH FANS

- **Accurately control temperature.**
- **Effect major savings in power.**
- **Reduce cost of control equipment.**
- **Eliminate by-pass piping.**
- **Prevent freezing even in extremely cold weather.**
- **Operate with standard pneumatic instruments.**
- **Have all moving parts of control mechanism completely enclosed and weather-proofed.**

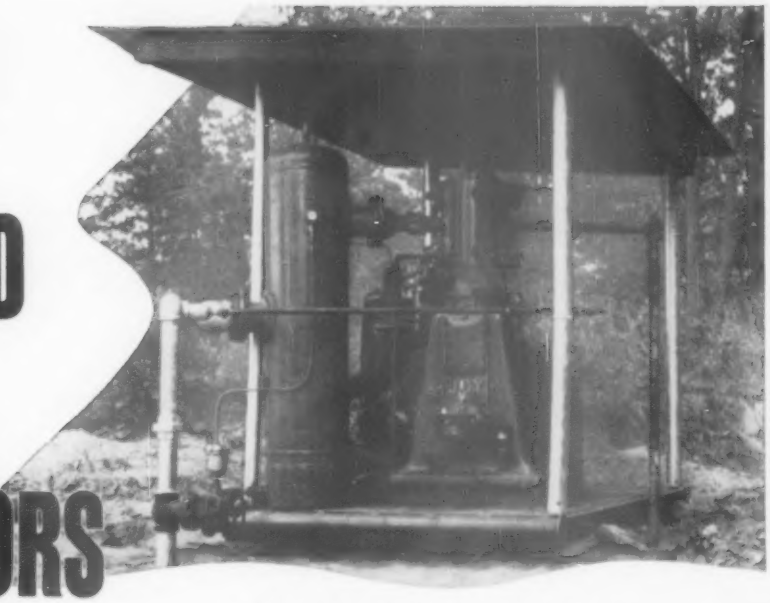
Hudson designs and manufactures cooling systems using water exclusively, air exclusively, and combinations of air and water. Objective comparisons are furnished without cost.

Hudson Auto-Variable Pitch Fan is protected by U. S. patents and patents pending.

HUDSON
ENGINEERING CORPORATION

FAIRVIEW STATION • HOUSTON, TEXAS

JOY PACKAGED GAS COMPRESSORS



JOY CLASS WGB-110 GAS COMPRESSOR:
Inlet pressure—50 Psig., Discharge Pressure—200 Psig., Capacity—.5 MMCFD.

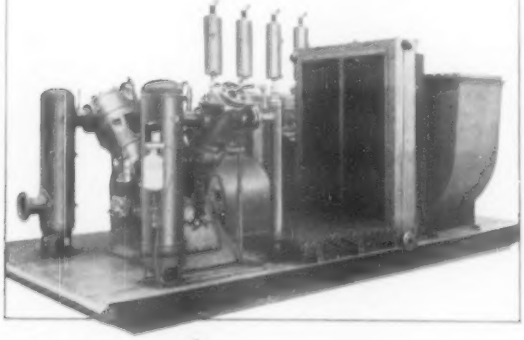
the only modern-design compressors for gas booster operation

No other gas compressors available today for booster service were designed as recently as the Joy Packaged Units, and offer as many modern advancements in design for field-proved economy and efficiency.

Best of all, these modern Joy Compressors are backed by a century-old reputation for low maintenance and long, uninterrupted operation. They are the most reliable you can put on the job for gas gathering, repressuring, or gas lifting . . . *because of these time-proved features:*

1. Field-replaceable cylinder liners.
2. Field-replaceable crosshead guides.
3. Patented Joy "Dual-Cushion" valves.
4. Full force-feed lubrication.
5. Anti-friction main bearings.

JOY CLASS WNB-112 GAS COMPRESSOR:
Inlet pressure—20 Psig., Discharge Pressure—650 Psig., Capacity—.8 MMCFD.



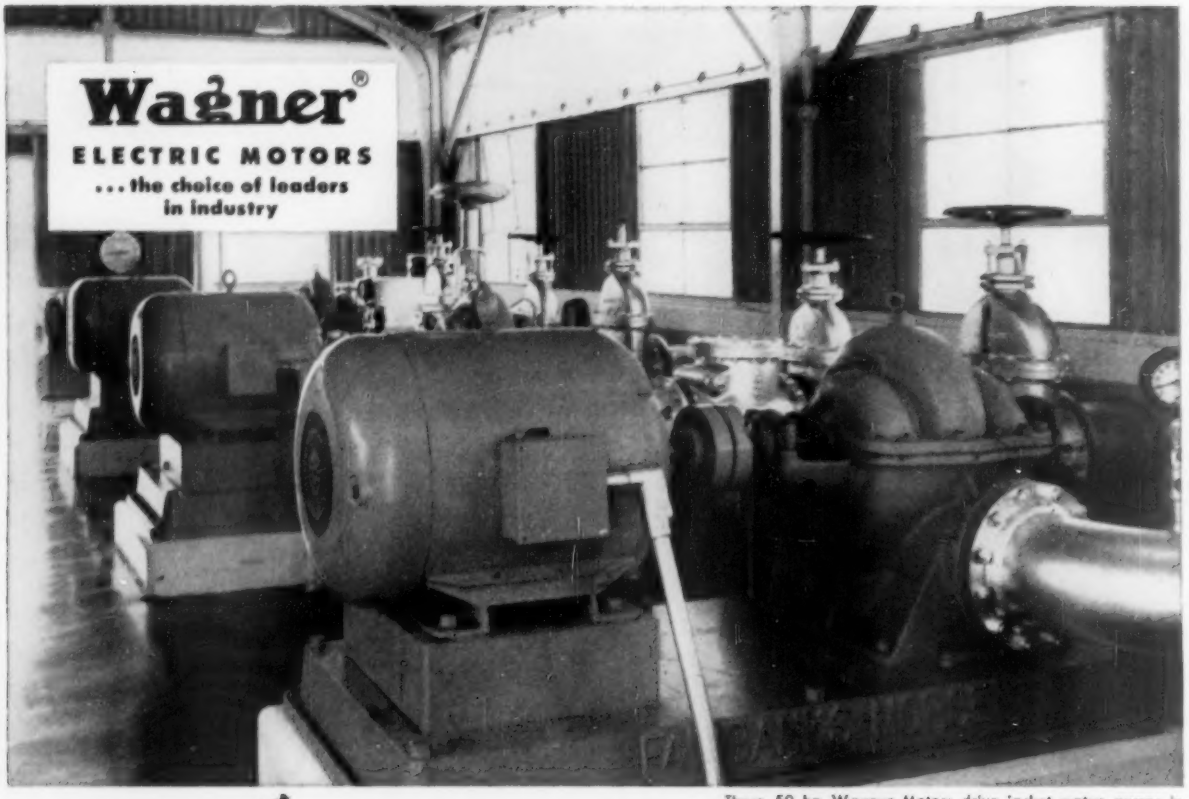
Available in vertical, V-type, and semi-radial designs for minimum space requirements, Joy gas compressors may be single- or two-stage units with cylinder sizes ranging from 3" to 13½". Four different frame types are available for a range from 50 to 400 H.P.

Your Joy representative can specify the most efficient compressor for your needs. Call him or write for Bulletin A-94. ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

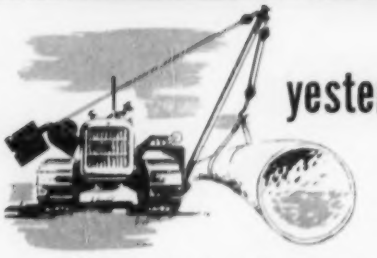
Consult a Joy Engineer

JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885



These 50 hp Wagner Motors drive jacket water pumps in TGT's main line gas booster station at Batesville, Mississippi



yesterday's pipe dream . . . today's miracle

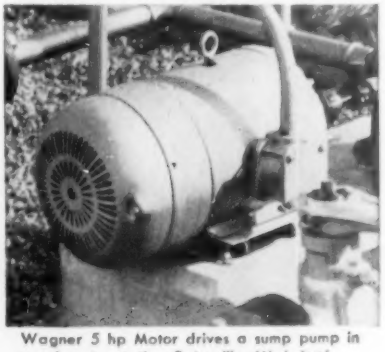
Like a giant artery, the Tennessee Gas Transmission Company's 2200-mile pipeline stretches from the heart of the natural gas fields underneath the plains of South Texas and Louisiana to the thickly-populated industrial East.

To give more convenience to the busy homemaker, to help teeming factories produce more goods—the tremendous volume of a billion-and-a-half cubic feet of natural gas moves through this underground highway each day.

In the last ten years TGT has increased eight-fold the capacity of its natural gas pipeline system and its installed compressor horsepower.

The Wagner Electric Corporation has had a hand in the expansion of such gas transmission systems. You'll find Wagner transformers at work in field processing plants. At booster stations, you'll find Wagner motors busy at their never-ending job of pumping, pumping, pumping . . . and, motors that drive pumps need plenty of electrical and mechanical stamina to hold up under the hard, steady grind.

Whether it's a job of pumping gas or any one of hundreds of other industrial operations . . . Wagner products can do the job economically and well. Wagner engineers are qualified to specify the correct transformers and motors for *your* requirements. Consult the nearest of our 32 branch offices, or write us.



Wagner 5 hp Motor drives a sump pump in gas booster station, Batesville, Mississippi

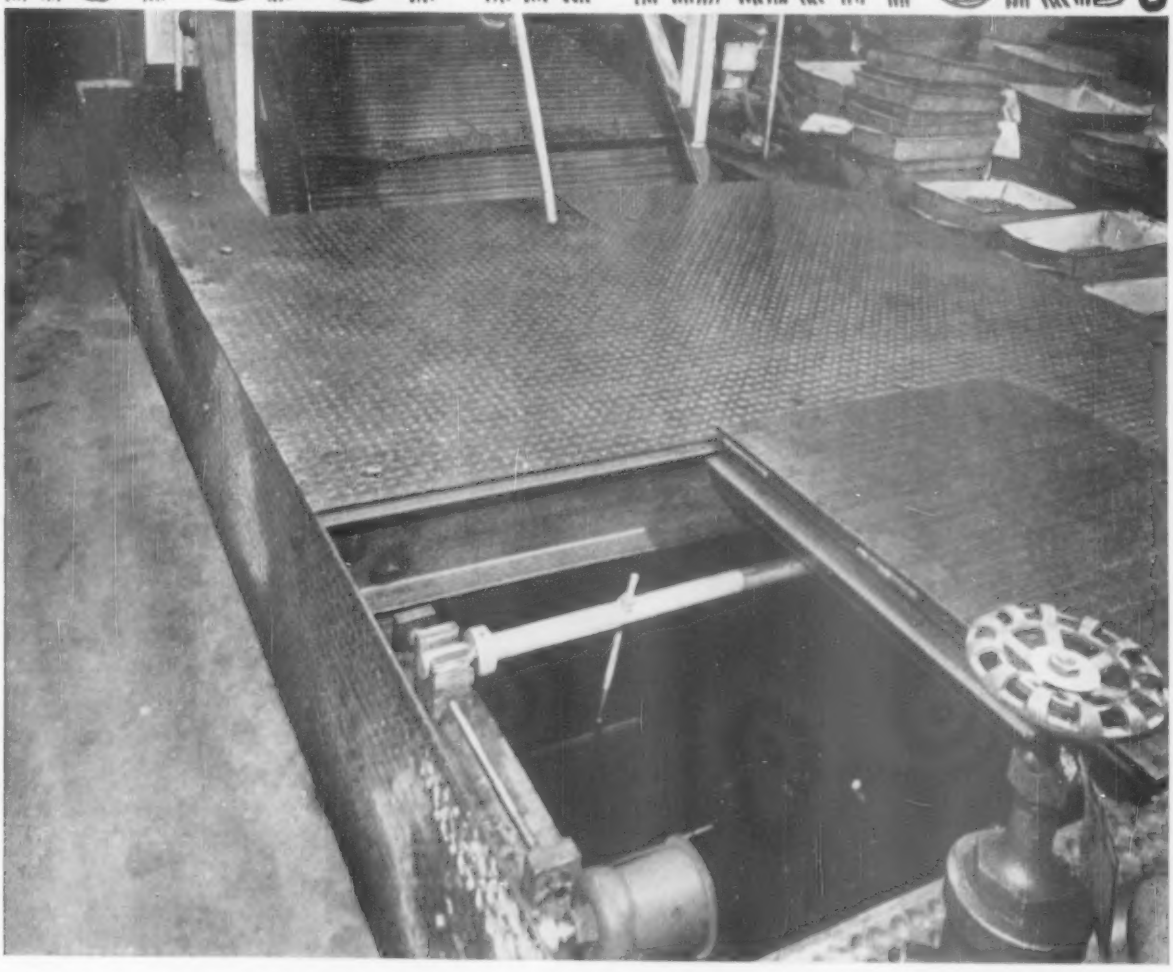
Wagner Electric Corporation
6389 Plymouth Ave., St. Louis 14, Mo., U.S.A.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

WM55-5

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES • AUTOMOTIVE BRAKE SYSTEMS–AIR AND HYDRAULIC

HOT SPOT IN HARTFORD!



1575 GALLONS OF OIL NEAR A 1700° FURNACE!

A king-size oil quench is a bad enough fire hazard by itself. Put it next to a roaring, 1700 degree hardening furnace, and it could turn a plant into a cinder pile!

So the Allen Manufacturing Company discovered when they installed this hardening and tempering machine in their Hartford, Connecticut plant!

From the hardening furnace, hex-socket screws are quenched in oil, tempered, then quenched again. A flash fire in the huge oil quenching bath could mean loss of the machine, costly down time—and possible loss of the entire plant!

Safety-minded Allen executives naturally took proper precautions, held the oil far below its flash point with thermostatic temperature controls. Still, they realized that more protection was needed!

So Allen called on Kidde—long-time specialists in fire extinguishing systems.

Kidde engineers studied the problem, installed a special carbon dioxide extinguishing system which could be triggered instantly.

If fire strikes, one pull on a control handle pours clouds of fire-killing CO_2 over the blaze, snuffing flames in seconds. At the same time, pressure-operated switches in the lines leading to the discharge nozzles automatically shut down feeds and conveyor motors!

All fire hazards—dip tanks, flammable liquids and electrical equipment—are potential plant-wreckers. Make sure they get the *proven* protection of Kidde extinguishing equipment. Call your Kidde agent today!

Kidde

The words 'Kidde', 'Lux', 'Lux-O-Matic', 'Fyr-Fyter' and the Kidde seal are trademarks of Walter Kidde & Company, Inc.

Walter Kidde & Company, Inc.
554 Main Street, Belleville 9, N. J.
Walter Kidde & Company of Canada, Ltd., Montreal—Toronto

THE BIGGEST

*Announcing**

THE LQ600 VALVE

ANOTHER LUNKENHEIMER "FIRST"
. . . the revolutionary new bronze valve which has broken all existing performance records!

LUNKENHEIMER THANKS ALL OF THE LEADING COMPANIES WHO COOPERATED IN THE FOUR-YEAR LQ600 FIELD TESTING PROGRAM

The LQ600 Valve has been tested for four years in carefully chosen "problem installations" in American industry. *Despite the poor records of previous valves, there was not one single reported case of failure or leakage of an LQ600 Valve!* Here are a few typical records:

LUNKEN

THE ONE *Great*

BRONZE VALVE NEWS IN 50 YEARS!

This revolutionary bronze globe valve has set completely new performance standards in the most severe service in industry!

LQ600 gives you so much *more* service per dollar that you can't afford to continue using bronze globe valves that require constant repair and replacement!

Valve users, cooperating in a four-year testing program, were unable to find *any* service tough enough to wear out an LQ600 — or cause it to leak, even in the most severe throttling installations! This new valve is an investment — one that pays cash dividends in maintenance savings year after year!

BRINALLOY* SEATS AND DISCS make these remarkable performance records possible. This exclusive new Lunkenheimer alloy is far more resistant to wear and corrosion than 500 Brinell Stainless Steel — even outwears case hardened Stainless Steel exceeding 1000 Brinell! There is no need for renewability. *No LQ600 Valve in four years service has required maintenance.*

OTHER FEATURES — a streamlined new exterior . . . the famous Stemalloy® Stem, which far outlasts any other stem material . . . the cool, easy-to-grip Non-Slip® patented handwheel . . . durable, high-strength bronze in body and bonnet . . . and true back-seating, permitting safe and easy repacking under pressure.

*Patented alloy. Trade Mark, The Lunkenheimer Co.

For more information, call your local Lunkenheimer Distributor or write The Lunkenheimer Company, Box 360, Cincinnati 14, Ohio.

TYPE OF SERVICE	LIFE OF OTHER VALVES	USER COMMENT
125 lb. hose steaming	2 wks. to 2 mos.	Toughest service, previous valves leaked.
Water col. blowdown	2 mos.	Plug valves couldn't take it.
185 lb. steam blowdown	1 yr.	Plug valves failed every year.
125 lb. steam blowdown	"Short"	Previous valve leaked every run.
200 lb. steam—water col. blowdown	2 mos.	Previous valves failed by wiredrawing.
Throttling syrup 140°F.	"Short"	Previous valves cut.
150 lb. throttling 388°F.	6 mos.	Plug valves failed regularly.
100 lb. throttling	2 wks. to several mos.	Plug valves couldn't hold up.
130 lb. throttling	8 mos.	Composition seat valves unsatisfactory.
110 lb. throttling steam	2 wks. to 3 mos.	Three other kinds failed.
Scaled hot water line	"Short"	About all makes used—none held up.
125 lb. throttling steam	6 to 12 mos.	Plug valves failed by wiredrawing.
150 lb. steam—scale present	"Short"	Previous valves broke.
150 lb. throttling steam	4 to 5 mos.	Other makes failed by wiredrawing.

HEIMER®

BRONZE • IRON
STEEL • PVC

NAME IN VALVES

L-455-4

TRACTOR-TYPE CRAWLERS OFFER GREATER MOBILITY TO PIPELINERS

Provide Important Advantages for Traveling Over Rugged and Steep Terrain

Performance reports on 15-B and 22-B excavators equipped with special tractor-type crawlers prove the value of this mounting on pipeline jobs. From New Mexico we've received this typical report:

"The country was rocky and, in places, the hills were so steep that tractor winches were needed both as an anchor in digging, and also to let the backhoes down the slopes when digging was completed. I noticed that the tractor-type treads on the 22-B's allowed them to travel and dig unaided in many places where machines, equipped with conventional treads, were helpless without tractors and winches."

And the ditch foreman on this spread says:

"Bucyrus-Erie machines stand up better on tracks, travel better, and the road gear saves time. I like the new tractor-type treads on hills, slick places, and on snow. They have more clearance and don't high center on rocky roads. The sealed bearings are also a very good feature."

That's the story. Equipped with sure-gripping crawlers, 15-B and 22-B dragshovels can climb grades as steep as 35%. Deep grousers provide sure traction. Ground clearance under housing is 16½" for 15-B and 20¾" for 22-B — enough to permit travel over stumps and other low obstructions. Special positive sealing protects all track-roller bearings from water, dust, grit, and dirt.

See your nearby Bucyrus-Erie distributor for details.

117E55

BUCYRUS ERIE

South Milwaukee
Wisconsin

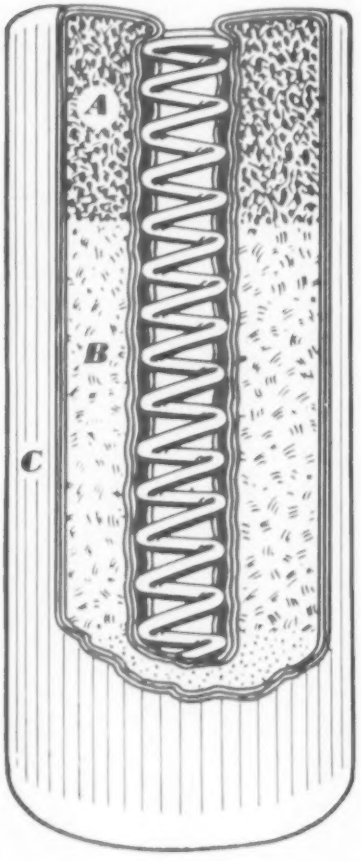
1880 **75** 1955
YEARS OF SERVICE
to Men Who
Shape the Earth

COMPLETE OIL FILTRATION IS NEVER SIMPLE

by CHARLES A. WINSLOW

Conditions under which most industrial engines operate may introduce grit, sludge, acid or moisture into lubricating oil. To remove these engine-destroying materials requires FULL FLOW filtration under cold and hot operations, without incurring back pressures, and with complete protection to critical surfaces in case of any part failure. Contaminants must be removed without affecting additives.

This complete protection for lubricants is not simple. It can best be accomplished with the four materials combined in Winslow CP* Elements. These elements are also designed for definite and predictable flow and pressure characteristics. When they are correctly applied, the oil is *all* filtered under *all operating conditions*, through these successive steps:



(A) CP* Material accepts varying percentages of oil flow, to maintain acceptable pressure.

(B) Combined thread and cellulose absorbs moisture and gums.

(C) The patented outside wrapper is an effective filtering medium.

CP* Material Gives Automatic Pressure Control

The specially treated CP material accepts varying percentages of the total oil flow, as conditions dictate; thus maintains acceptable pressure losses without opening by-pass valves, and insures 100% Full Flow filtration at all times. All harmful particles are removed from the oil.*

Cotton Thread Combined With Cellulose Fibre

The cotton thread is porous and fluffy for full dirt retention, and creates a multitude of intricate passages to catch minute particles. It is combined with clean, dry cellulose fibre, which prevents packing and channeling of the filtering media. This selected fibre also absorbs gums, moisture and varnish that may be present in the oil.

The fourth filtering media is the patented double wrap of tubular cotton on both the inside and outside of the Winslow element.

Proportion of Materials Determines Pressure

In a Winslow CP* Element the ratio of filter materials determines the rate of oil flow through the element. This ratio is set for each size and type CP* element, based on laboratory and field tests.

Element Packed for Progressive Filtration

Each Winslow CP* Element has the same amount of material at the outer area as there is near the center. Obviously the material is more condensed at the center. This forms V-shaped traps for progressively smaller particles, increasing the capacity and useful life of the element. The tubular cover is also squeezed tighter at the center and is more open at the outside.

This combination of exclusive Winslow features and materials has been proved for years, under severe engine service, to be the most efficient and in the long run, the most economical method of lube oil filtration. We will be glad to give you complete data on filters and elements for your equipment. Please write or call the nearest office.

WINSLOW FILTERS **CP is fully protected by patents and trademarks*

Winslow Engineering Company 4069 Hollis Street • Oakland 8, California

NORDBERG
Supairthermal®
ENGINE GEAR SET
for reducing gas pipe line transmission costs . . .

☆ *THERMAL EFFICIENCY IN EXCESS OF 40%*

☆ *LOWEST INSTALLED COST*

Savings of thousands of dollars per day in fuel costs on large capacity gas pipe lines can be realized with the Nordberg *Supairthermal* engine gear set, driving a centrifugal gas compressor, for the simple reason that less fuel is required to transport gas than by any other modern type of equipment.

This performance is possible through exclusive design principles which produce a thermal efficiency of better than 40 per cent—with increased horsepower, lower lube oil consumption . . . and lower maintenance costs per horsepower-hour.

Extremely compact and efficient, this unit can be installed with lower capital investment and operated at lower cost per horsepower-hour than any other type of gas pipe line prime mover.

Call or write for full details, outlining your requirements.

Nordberg *Supairthermal* V-type spark-ignition gas engine driving a centrifugal gas compressor. V-type engines for this service are built with 10, 12, 14 and 16-cylinders, offering a range up to 5,000 horsepower per engine.

NORDBERG

DIESEL • DUAFUEL® AND SPARK-IGNITION GAS ENGINES

© 1955, Nordberg Mfg. Co.

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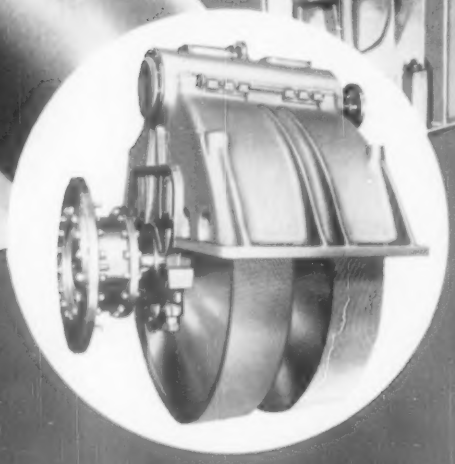
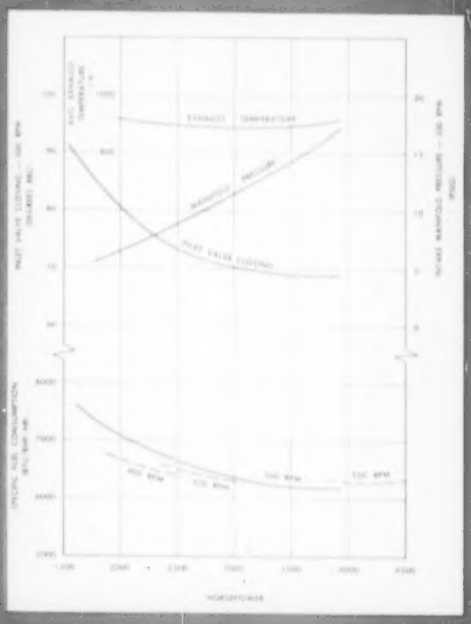


NORDBERG SPEED INCREASING GEAR...

The Nordberg *Supairthermal* engine drives the gas compressor through this compact close-coupled speed increasing gear, mounted on the bedplate extension of the engine. Latest engineering design advancements are incorporated in this gear for continuous, quiet operation and long life. A range of gear ratios from 6:1 to 10:1 is available in the built-in gear set without changing gear casings. This flexibility is highly desirable for future line capacity expansion.



A typical Nordberg V-Type 16-cylinder *Supairthermal* Spark-Ignition Gas Engine performance chart.

NORDBERG MFG. CO., Milwaukee, Wisconsin

Builders of America's Largest Line of Heavy Duty Engines . . . 10 to over 12,000 Horsepower

stainless steel, too, means more than a shining face

A healthy youngster's natural grin is "chromium plated" after a conflict with soap and water. But it's his all-the-way-through character that measures his ability to cope with problems.

That's the way it is with stainless steel. And—important fact—varying amounts of chromium and other metals can be alloyed with steel to give stainless the specific all-the-way-through character needed to meet special problems.

Sun Ship has earned a reputation for mastering many special problems in its decades of service to the chemical, petrochemical, petroleum and other industries which face problems in fabrication and specialized machinery.

Now, with its new segregated Alloy Products Shop in operation, Sun Ship is using its experience and precise workmanship to adapt the superb qualities of stainless steel and other alloys to the equipment needs of the many industries it serves. In this shop are fabricated all grades of stainless, alloy, and aluminum.

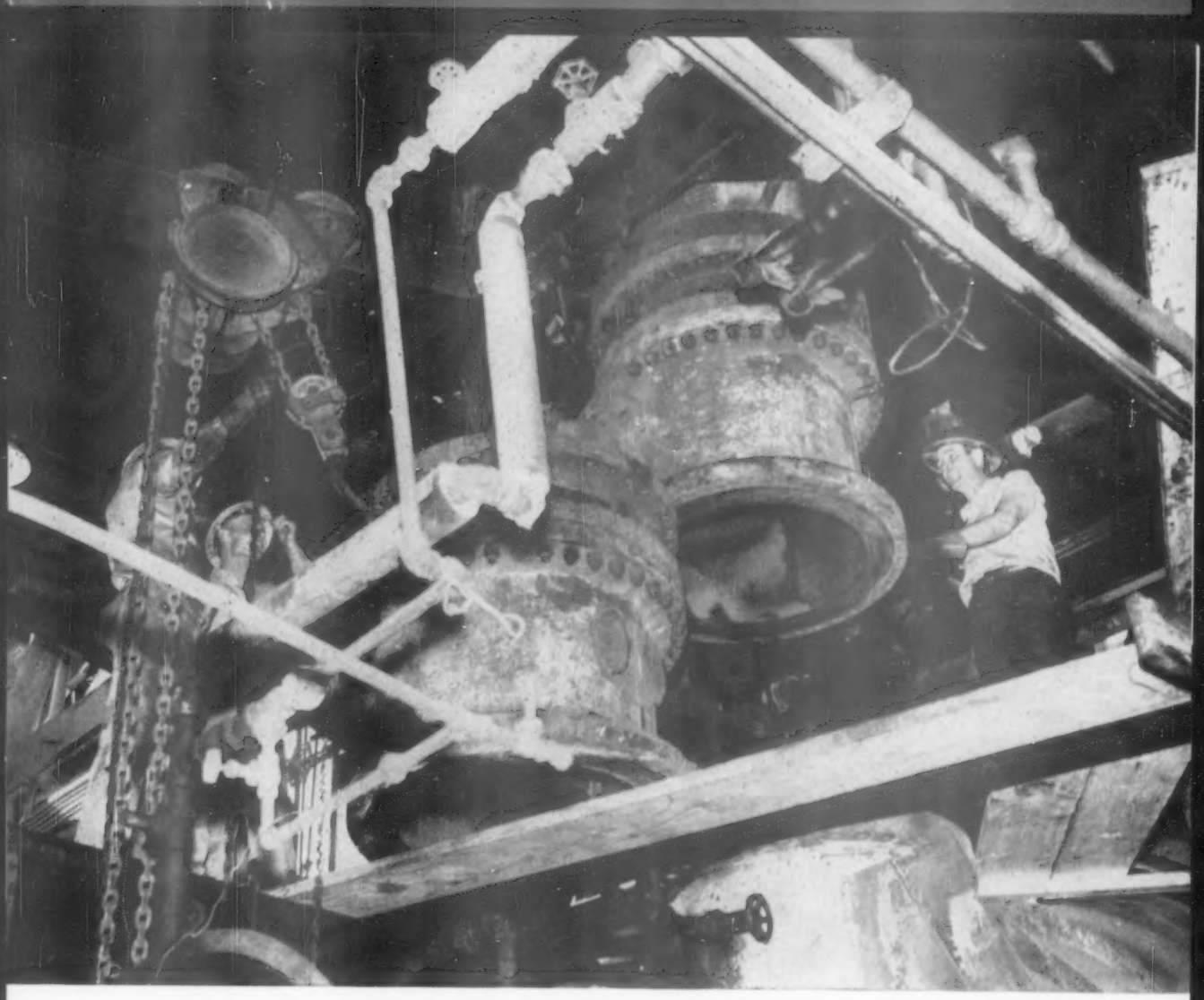
Our Sales Engineering Department will be glad to discuss the value of this shop and its products in meeting your specific problems.

Sun Ship also makes all types of carbon steel pressure vessels.

ALLOY PRODUCTS SHOP

OF Sun SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE • **CHESTER, PA.** • 25 BROADWAY, NEW YORK CITY



TURNAROUNDS BY PROCON

During the first quarter of this year, seven petroleum refineries have entrusted Procon with their turnaround projects, knowing that their on-stream operations would be resumed after just a short period of down-time. With the rapid completion of this important preventive maintenance work, these refiners were assured of continuous trouble-free operations in the production of high-quality petroleum products.

The outstanding record achieved on these projects is typical of the many services available to refiners when Procon is on the job. It will be to your advantage to plan your next turnaround operation with Procon.

PROCON *Incorporated*

1111 MT. PROSPECT ROAD, DES PLAINES, ILLINOIS

PROCON (CANADA) LIMITED—40 ADVANCE ROAD, TORONTO
PROCON (GREAT BRITAIN) LIMITED—112 STRAND, LONDON

WORLD-WIDE CONSTRUCTION FOR THE PETROLEUM, PETROCHEMICAL, AND CHEMICAL INDUSTRIES

Another submarine crossing for NATIONAL SEAMLESS...

Welded sections of National Seamless Pipe being ramped into the river from the lay barge. Barges at left assisted in laying-in operations. In the background is the huge 212-foot dredge used in the crossing.

This 18-inch diameter, 1⅛-inch wall National Seamless Steel Pipe weighed 208 pounds per foot. Due to its thickness, weights and special coatings were unnecessary.

The ramp of the lay barge. Welding of this heavy-wall pipe was slow—taking about four hours for two welders to complete one weld, using 3/16-inch rod.

National Seamless Pipe being welded into 80-foot sections on the river bank. The dredge is at work in the background. An estimated 3,000,000 cubic yards of earth had to be dredged to prepare a ditch for the pipe.

WALLS WITHOUT WELDS

TENNESSEE GAS TRANSMISSION COMPANY LAYS THREE 18-INCH LINES OF NATIONAL SEAMLESS PIPE ACROSS MISSISSIPPI RIVER

This new crossing of the Mississippi consists of three lines of National Seamless Pipe, laid parallel, 100-feet apart in a downstream loop in the bed of the river. On either side of the river, the three lines tie into the Tennessee Gas Transmission Company's new 576-mile 30" O.D. line, running from the Kinder, La., compressor station to Portland, Tenn. The Kinder-Portland line gives the company a direct connection for moving gas from south Louisiana and the Gulf of Mexico to eastern markets.

The preliminary preparations consisted of cleaning, priming, coating, and double-wrapping the 18-inch National Seamless Pipe. It was then welded into 80-foot sections on the river bank, and transferred to a barge. As the pipe was needed, it was transported to the laying barge in the river, where the 80-foot sections were welded together in a continuous line. A huge ramp on the laying barge was then used to ease the pipeline into the water.

Submarine crossings are among the most difficult and costly of pipeline installations. A suitable crossing spot has to be chosen very carefully. Dredging operations sometimes entail the moving of millions of cubic yards of earth. And once the pipe is laid, it has to be there permanently. It must withstand great pressures, absorb distorting and bending stresses. To do this, the pipe has to be strong, and extremely flexible. It has to be "trouble-free" for years and years to come. In short, it has to be USS National Seamless Steel Pipe.

NATIONAL TUBE DIVISION
UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

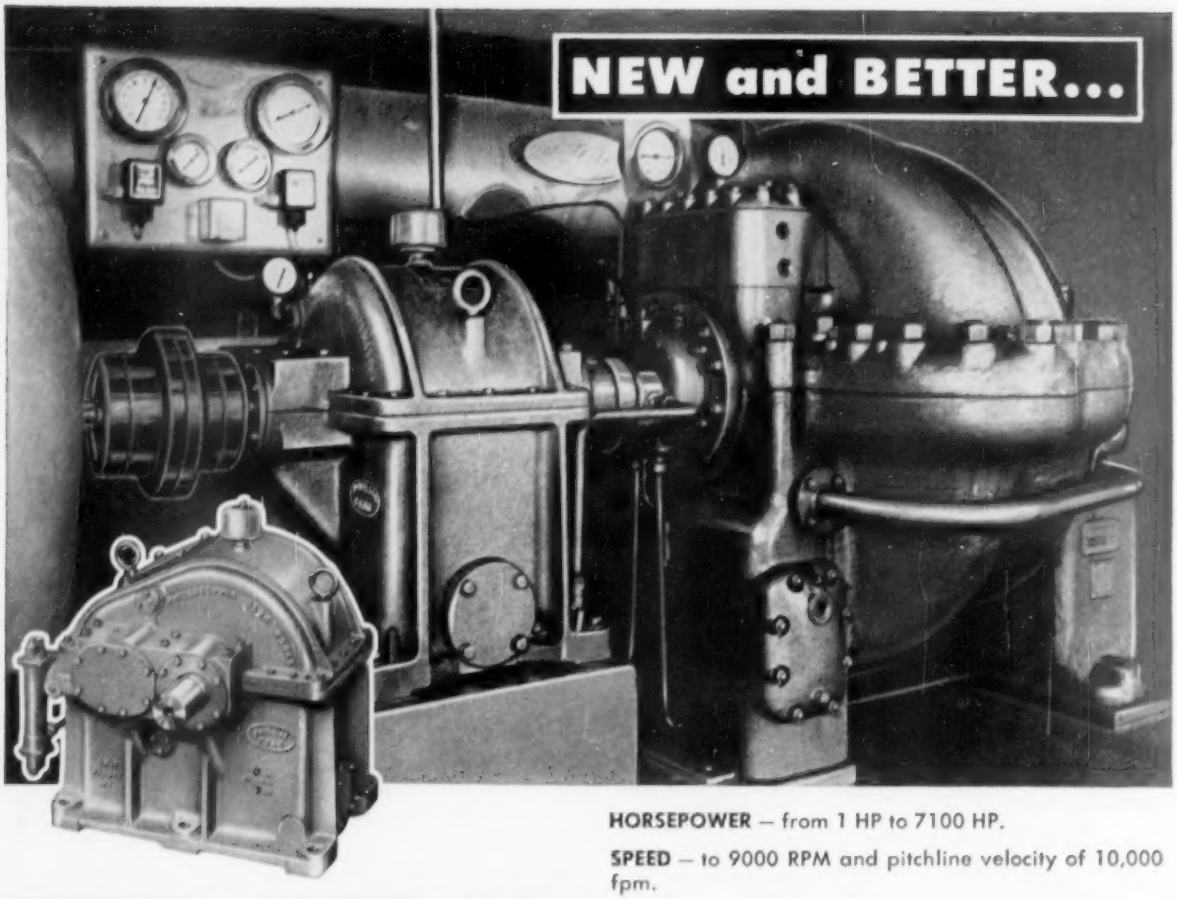
SEE THE UNITED STATES STEEL HOUR. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

NATIONAL SEAMLESS PIPE AND TUBES

IN RIVER CROSSINGS TOO — SEAMLESS DOES IT BETTER

USS

UNITED STATES STEEL



PHILADELPHIA "HI-SPEED" SPEED REDUCERS AND INCREASERS

The new standardized Hi-Speed units contain all the features and advantages of "custom built" gear reducers. These rugged Philadelphia drives, available for both Industrial and Air Conditioning Service, are designed and manufactured specifically for the reducer or increaser application where rotating speeds range as high as 9000 RPM or pitch line velocities up to 10,000 feet per minute.

All rotating gears and shafts are dynamically balanced to provide the ultimate in vibration-free power transmission. Philadelphia Hi-Speed Units meet the modern trend toward higher prime-mover speeds of steam turbines, ultra high speed electric motors and internal combustion engines for driving compressors, pumps and mills through Speed Reduction Units. They are also used as *Speed Increasers* to drive high speed compressors, generators, pumps and fans.

DESIGN — in accordance with latest practices of the American Gear Manufacturers Association.

HORSEPOWER — from 1 HP to 7100 HP.

SPEED — to 9000 RPM and pitchline velocity of 10,000 fpm.

RATIOS — from 1:1 to 10:1 for either speed reduction or increase.

HOUSINGS — are quality gray cast iron of generous proportion, with heavy bearing bosses to provide rigid mounting for rotating parts.

GEARS — are double opposed helical type, designed to spread tooth load over three or more teeth. Thrust forces produced by helical gearing are completely balanced by opposed helical faces. Gear and pinion teeth are cut by hobbing process, finish-shaved to produce most accurate tooth contours. Gearing is dynamically balanced. Gears are manufactured from stress relieved alloy steel castings.

SHAFTS — are completely machined, with bearing surfaces hardened, ground, and polished.

BEARINGS — are babbitt lined, bronze backed precision type "sleeve" construction, which have become synonymous with high speed shaft rotation.

LUBRICATION — positive, force - feed, self - contained system, with spray nozzles to entire gear face at line of contact, and separate pressure lines to each bearing.

Send for Catalog HI and be convinced

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NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.
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Established 1892

THEY ENLARGED THEIR COMPRESSOR STATION

Northern Natural Gas Company decided to enlarge their compressor station at Tescott, Kansas. This station had originally been constructed by Pritchard. It was equipped with three gas turbine compressor units with a total of 34,200 horsepower, built at a cost of less than $250 per horsepower!

THEY CHOSE PRITCHARD AGAIN

Experience proved that Pritchard was able to get a job done right, right on time. Pritchard's complete package contract saved time and money. Each segment of the planning and installation was completed by Pritchard personnel on a carefully coordinated engineering, purchasing and construction schedule. Pritchard is ready to offer you the same type of high caliber planning. Next time, choose Pritchard.

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It's a big step forward in an already superior oil field supply service. We have shortened the time and distance between your rig and your United Supply store to give you the very best service in the field. It's another good reason to "rely on United Supply!"

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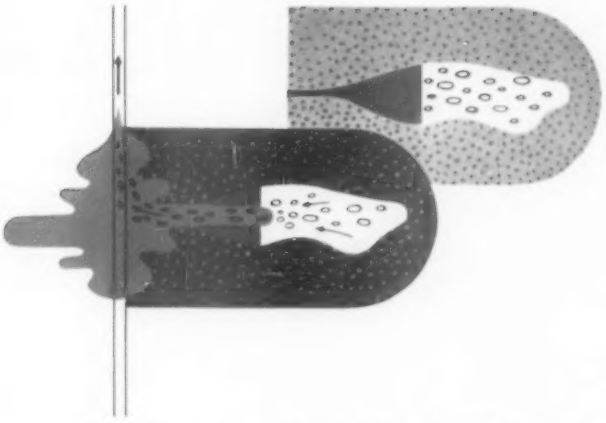

BREAK DOWN BLOCKS, STEP UP PRODUCTION

WITH MCA AND HYFLO

HALLIBURTON'S PROVED EMULSION BREAKERS

You can measure the effectiveness of Halliburton's exclusive clean out agents by measuring the increased production in your well after a treatment with MCA or Hyflo. When viscous emulsions and water block slow down—or shut down—your production, an economical clean out treatment will help restore the original permeability that is necessary for free flow of oil.

Hyflo is the new chemical agent that removes water and emulsion blocks in oil producing formations and breaks through the viscous emulsions that may be formed with refined fracturing oils. With only one or two hours of shut-in time, Hyflo treatments have effectively removed emulsions, lowered the surface tension of water and reduced the interfacial tension between oil and water.

Double action MCA, Halliburton's Mud Cleanout Agent, is particularly effective in bentonitic sands where water-swollen particles of bentonite block void spaces and greatly reduce permeability. The combined force of a highly active surfactant and hydrochloric acid are used in MCA to shrink bentonite, dissolve calcareous material, break water blocks, destroy water-oil emulsions and disperse mud or detritus.

In old or new wells, where low permeability is causing low production, plan to free plugged pay with Hyflo or MCA. Your nearby Halliburton operator can give you full information on the production-boosting results of these agents and help you select the right service for your well. With either Hyflo or MCA, you'll be sure of using the most effective and economical agent for breaking production blocks and production records. Call your local or district office of the Halliburton Oil Well Cementing Company.

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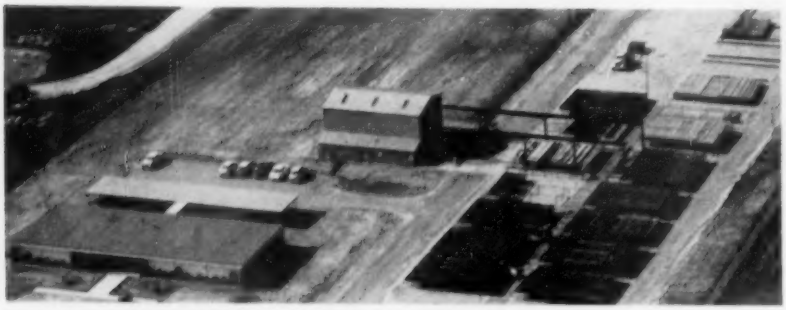
211 SERVICE CENTERS — JUST MINUTES AWAY FROM ANY RIG

EQUIPMENT MEN . . . in the News



Associated Oil-Field Rentals Completes Headquarters

The new main office and yard of Associated Oil-Field Rentals, renters of pipe and equipment to the oil and gas industry, is located on Holmes Road in the industrial southeast section of Houston. This firm, a subsidiary of Associated Oil & Gas Co., specializes in providing modern equipment from a large and complete stock. Ten other yards are located in the Southwest.

Williams to Manage Cummins Distribution

L. E. WILLIAMS

The promotion of Loyd E. Williams to manager, distribution, Cummins Engine Co., Inc., Columbus, Ind., has been announced by C. R. Boll, general sales manager.

Williams had been Rocky Mountain regional manager for Cummins since March 1950. His headquarters were in Denver. In his new position, Williams will be in charge of the operation of the company's 12 regional offices and the handling of domestic distributor activities. He succeeds Paul J. Every, who is now assistant general sales manager.

Gearty Is Guest Speaker at Los Angeles Nomads Meet

Guest speaker at the April meeting of the Los Angeles chapter of Nomads was Thomas Gearty, special agent of the Federal Bureau of Investigation and assistant special agent in charge of the Los Angeles office. He is here shown with Joe Schlarb, chapter president, on his left; and Bob Gaylord, sergeant-at-arms; and Rex Collins, deputy sergeant-at-arms, to his right.

Crutcher-Rolfs-Cummings Names Two to Sales Staff

Crutcher-Rolfs-Cummings, Inc., has announced the appointment of two additional men to its sales and service staff. They are L. E. (Kansas) Reed and E. L. (Jack) Henry.

L. E. REED

E. L. HENRY

Reed has had wide experience in the pipeline industry in both foreign and domestic oil fields. He worked on pipelines in Iraq for a number of years.

Henry has rejoined Crutcher-Rolfs-Cummings after serving with the Barrett Division of Allied Chemical & Dye Co. and the pipeline department of several of the larger pipeline companies.

Republic Supply Opens Store at Kimball, Neb.

A new store has been opened at Kimball, Neb., by Republic Supply Co., Oklahoma City, according to an announcement by M. N. Amsden, vice president and general manager of sales.

J. H. Smith is store manager, and C. J. Jump is district manager for this area with offices in Denver. Republic has now 46 stores and 13 sales offices in 10 states.

McCullough Names McGuffin Williston Sales Engineer

D. McGUFFIN

Douglas McGuffin has been promoted to the position of sales engineer in the Williston basin area, according to a recent announcement by I. J. McCullough, president of McCullough Tool Co. in Los Angeles. Before joining McCullough in 1954, McGuffin spent several years with the Byron Jackson Service Co., working as a sales and service representative. Prior to his recent promotion, McGuffin was in McCullough's service department, gaining experience in services and operating procedures.

As sales engineer, McGuffin will be working out of McCullough's Williston, N. D., branch office under Harry Whittaker, branch manager.

Detroit Diesel Adds To Field Organization

Due to an expanded and more complex diesel-engine market and new models added to its line of industrial and marine diesels, Detroit Diesel Engine Division of General Motors Corp. has added five more sales and service representatives to its administrative field organization.

The new representatives have been shifted from home office sales and service departments in Detroit. The men appointed and their territories as announced by E. F. Bentley, Detroit Diesel's general sales manager, are: G. R. Holly, sales representative, covering Arizona, New Mexico, and Utah; Stanley Partel, sales representative, covering the Dakotas, Minnesota, and Eastern Iowa; K. L. Post, service representative in Colorado, Montana, Nebraska, and Wyoming; Vance Shields, service representative in northern Illinois, Michigan, and Wisconsin, and R. A. Stephens, service representative, covering western New York, Ohio, western Pennsylvania, and West Virginia.

Byron Jackson Acquires Pipe-Protector Patents

Byron Jackson Co. has acquired patent rights from Huntsinger Associates

made for rugged use... *in plant—office or field*

Gotkool

water cans and coolers

"GOTKOOL" Water Cans are easily portable for field use... and **"GOTKOOL" Water Coolers** are especially designed for use in office, store, or plant. Both have extra large top openings. Snug-fitting, easily removable tops protect water from impurities. Heavy construction with heavy double-locked, sweat-soldered seams. Buy **"GOTKOOL"** *at your supply store today.*

GOTKOOL Water Cooler — made in 2, 3, 5, 8, 10, 15, and 20-gallon sizes with extended or recessed flush-mounted faucet optional. *(Note: 15- and 20-gallon sizes available with extended faucet only.)*

GOTKOOL Water Can — made in 1½, 2, 3, 5, 10, and 20-gallon sizes without faucets. Extended or recessed flush-mounted faucets available at slight additional cost. *(Note: 15- and 20-gallon sizes available with extended faucet only.)*

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WATER SEPARATOR STRAINER

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Now equipped with quick opening closures and other easy service features.

DIVISION OF FRAM CORPORATION

for the Vetco "Off-n-on" drill-pipe and casing protector, formerly manufactured and distributed by Ventura Tool Co.

Patent transfer is retroactive to March 28, 1955, according to an announcement made recently by E. S. Dulin, president of Byron Jackson Co.

This addition to the line of PB rubber products will be known as the PB Safe-Lok protector. It will be manufactured at Byron Jackson's PB rubber plant in Los Angeles and distributed by the company's oil-tool division.

Lummus Elects Curtis As Vice President

James H. Curtis has been elected vice president of The Lummus Co., New York, designing engineers and constructors for the petroleum and chemical industries. This was announced recently by J. F. Thornton, president.

Curtis, who was at one time manager of manufacturing for General Petroleum Co., formerly was assistant to the president of Lummus.

In other Lummus appointments announced at the sime time, D. R. Breien, company treasurer, was elected secretary and treasurer; Mario J. Marchione, assistant treasurer, was elected assistant secretary and assistant treasurer; and Theodore F. Brophy, company counsel, was made assistant secretary.

Englert Named Manager of Girdler Catalyst Sales

Earl Englert has been appointed manager of catalyst sales for the gas-processes division of The Girdler Co., Louisville, Ky. Girdler is a division of the National Cylinder Gas Co., Chicago. Catalysts are employed in the production of synthesis gas and hydrogen, and in hydrogenation and gas-purification processes.

Englert began his business career with the central research department of the Monsanto Chemical Co. in 1947. He joined Girdler in 1950 and was a member of the engineering department until 1952. From 1952 to his present assignment he was a sales engineer in the company's New York office.

Oilwell's Gulf Coast Area Announces Three Changes

The appointment of Victor H. Blott as store manager for "Oilwell" at Victoria, Tex.; transfer of William H. Beasley, field representative of Oilwell from Beaumont, Tex., to Harvey, La.; and the appointment of Burley N. Pedigo as field representative at New Iberia, La., have been announced by Melvin F. Jones, Gulf Coast area manager of U. S. Steel's Oil Well Supply Division.

Blott was employed by "Oilwell" in 1947 at Mission, Tex., and later worked at Mirando City and Victoria, Tex. In 1952 he was transferred to Corpus Christi, Tex., and 1 year later was appointed field representative at Victoria. In 1954 he was appointed district representative for expendable pump parts at Victoria, the position he held until his recent appointment.

Beasley was employed in 1936 at the firm's Pampa, Tex., store. In 1942 he left the organization's employ for a time, returning in 1948 as storeman at Beaumont. In 1950 he was transferred to the Eunice, La., store. After 2 years in this post he was transferred back to Beaumont and in 1954 was appointed field representative.

Pedigo was employed in 1953 at the New Iberia store. He worked in this store until his present appointment.

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Here, in the Robinson Rigid Duplex Line Blind Valve, you are assured a positively leak-proof line shutoff, easy to operate. No spreading of lines or loss of fluid. Available as an orifice fitting.

The "O" rings, inserted in dove-tailed grooves of the flow controlling member provide a positive seal against any possible leaks. Pressure from the flowbore exerts itself against the "O" ring, making an ideal leak-proof seal.

Extremely simple in design with very few parts, no gears, sleeves or special packings other than the two "O" rings, this rugged line blind valve is available in sizes from 2" to 16", from 150# to 1,500# ASA. Insist on Robinson and be SAFE.

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ECON-O-BLIND

You'll find the Robinson ECON-O-BLIND an excellent answer to positive shutoff problems. It is a rigid type blind and the most economical on the market today. The ECON-O-BLIND incorporates the Robinson replaceable "O" ring seal and is available in sizes 2" to 16", 150# to 600# ASA.

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OLDEST NAME IN ORIFICE FITTINGS

LaFave to Head Childers Jacketing Sales

J. C. LaFAVE

Appointment of John C. LaFave as manager of jacketing sales has been announced by Bob Childers, president of Childers Manufacturing Co., manufacturers of aluminum weatherproof jacketing.

LaFave joins Childers after 5 years of service with the United Trading Stamp Co. Since 1953 he has served as district manager of the Midwest area for the trading stamp firm.

Dresser Industries Names Two Vice Presidents

H. P. BONCHER

H. N. Mallon, president of Dresser Industries, Inc., Dallas, announces the appointments of H. P. Boncher and W. D. Miller as operating vice presidents of Dresser Industries, effective May 1, 1955. F. G. Fabian will succeed Boncher as general manager, Dresser Manufacturing Division, Bradford, Pa.

Boncher, who had been general manager of Dresser Manufacturing since 1942 and a vice president of Dresser Industries, Inc., since 1951, will have operating responsibilities for the following Dresser companies: Dresser Manufacturing Division, Bradford, Pa.; Bovaird & Seyfang, Bradford, Pa.; Clark Bros. Co., Olean, N. Y.; Dresser-Ideco Co., Columbus, Ohio; Pacific Pumps, Inc., Huntington Park, Calif.; Roots-Connersville Blower Division, Connersville, Ind.

W. D. MILLER

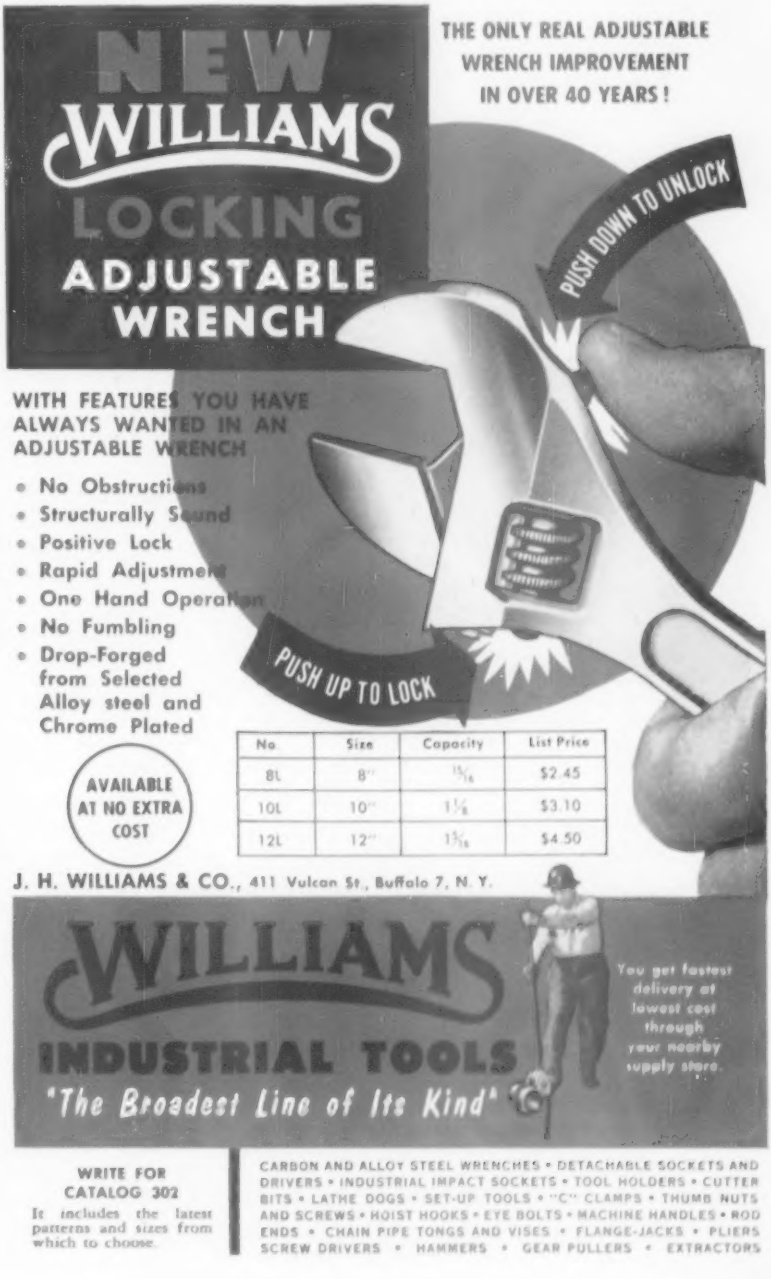
F. G. FABIAN

Miller, whose previous experience includes 10 years in an executive capacity with Creole Petroleum Corp. in Venezuela, joins Dresser where he will have similar operative responsibilities for the remaining members of the Dresser group: Magnet Cove Barium Corp., Houston; Lane-Wells Co., Los Angeles; Security Engineering Division, Dallas; Ideco Division, Dallas.

No changes in the present top management of any of these Dresser organizations are contemplated. The company executive heads in each case will continue to direct their own company or divisional operations, but will report to Boncher or Miller in accordance with the above assignments. These two men, in turn, will be responsible to J. B. O'Connor, executive vice president of Dresser Industries. Both Boncher and Miller will headquarter at Dresser's general offices in Dallas.

Boncher joined Dresser Manufacturing Division in 1921. He was appointed assistant sales manager in 1930; sales manager in 1938; and general manager in 1942.

Miller had extensive experience in drilling, production and pipeline operations in the Mid-Continent area from 1923 to 1937. Following intensive field experience on drilling rigs and in general-production operations, Miller practiced petroleum engineering for a major oil company and its subsidiaries throughout the Mid-Continent area, terminating these activities as production superintendent. His sales and service experience was with Dowell Incorpo-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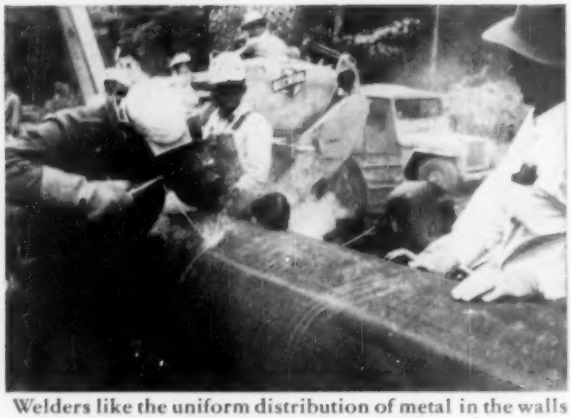
CARBON AND ALLOY STEEL WRENCHES • DETACHABLE SOCKETS AND DRIVERS • INDUSTRIAL IMPACT SOCKETS • TOOL HOLDERS • CUTTER BITS • LATHE DOGS • SET-UP TOOLS • "C" CLAMPS • THUMB NUTS AND SCREWS • HOIST HOOKS • EYE BOLTS • MACHINE HANDLES • ROD ENDS • CHAIN PIPE TONGS AND VISES • FLANGE-JACKS • PLIERS SCREW DRIVERS • HAMMERS • GEAR PULLERS • EXTRACTORS

Internal Lineup Clamp helps bring together two joints of 30" Republic Fusion Weld Line Pipe. Crews find that ends of Republic Line Pipe match up consistently, saving considerable installation time.



Welders like the uniform distribution of metal in the walls of Republic Line Pipe. It provides a good solid base for the root weld, guards against thin spots that might burn through, causing delays.

REPUBLIC CASING AND TUBING GOES IN FAST, TOO. The uniform roundness of these quality products, plus clean, full-formed threads assure fast stabbing, spinning and tonging-up. Uniform thickness of steel under the thread roots guards against disastrous pullouts. And the high-yield strength steel is extremely resistant to collapse. Republic makes both Electric Weld (in grades H-40 and J-55), and Seamless (J-55 and N-80). Order from your Republic Distributor.

THIS PIPE WELDS WITH A BRUSH, can be cut with an ordinary handsaw. It's Republic's Semi-Rigid Butyrate Plastic Pipe—the lightweight, easy-to-handle pipe that joins quickly—reducing installation costs. Moreover, it resists soil corrosion, electrolytic action—plus costly paraffin buildups. Ideal for transmission of high paraffin crudes, sour crudes, salt water and raw gas. Send coupon for facts. Also ask for information on Republic's new addition—Semi-Rigid Kralastic.

REPUBLIC'S LINE PIPE LINEUP IS TOUGH TO BEAT

Uniform roundness and straightness assure quick alignment—fast welding

No matter what size the pipe—or how long the line—installers appreciate the consistent uniformity of Republic Line Pipe. Jobs are completed faster, with less difficulty. Laying schedules can be set, knowing that they'll be met—and often bettered.

Take Republic Electric Fusion Weld Line Pipe, for example. No time is lost searching for true-fitting ends. Because circumference is always constant, field joints line up accurately. As a result, the entire perimeter can be welded at top speed.

Good welds are easy to make, too. Since uniform wall thickness assures an even distribution of metal all around the pipe, you can count on dependability in every inch of the line—with no thin spots to worry about.

Republic Electric Resistance Weld Line Pipe enjoys these same high standards of quality. Due to its highly ductile steel, it also bends uniformly and smoothly in the shop or field. And a uniform high-yield strength makes both of them ideal for building high-pressure lines.

Specify this dependably straight, scale-free line pipe for your next job. Electric Resistance Weld comes in sizes 2⅜" through 16" O.D. and Electric Fusion Weld from 24" through 30" O.D. Republic's old standby, Continuous Butt Weld, is also available in sizes ⅛" through 4" nominal.

Let Republic help you with your transmission, gathering, distribution, and product line problems. Call us—or send coupon for descriptive literature.

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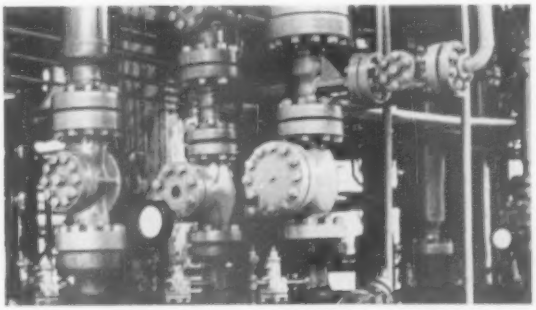

YOU CAN COUNT ON MAXIMUM PROTECTION for your high-pressure equipment when you use Republic Alloy High-Resistant Steel Studs. Clean, accurate threads with ample full-engaged thread area—together with top-quality Republic alloy steels—mean dependable strength and performance—even under extreme pressures, extreme heat and corrosion. Specify Republic Alloy High-Resistant Steel Studs on your next order. And keep a supply on hand for your replacement needs.

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rated, where he gained a valuable background in engineering, sales research, and district management from 1937 through 1944.

S.S.C. Elects Barthelmes And Finn to Be Directors

R. S. Finn was elected to the board of directors of Seismograph Service Corp., Tulsa, and Albert J. Barthelmes was named executive vice president of

R. S. FINN

BARTHELMES

the company at the annual stockholder meeting of S.S.C., President G. H. Westby announced.

Finn is vice president of Lorac Service Corp., a subsidiary of S.S.C., and Barthelmes has been serving as a vice president of Seismograph Service.

Other directors reelected at the meeting included Falkner C. Broach, Amasa B. Chappell, Ralph W. Davis, James E. Hawkins, Forrest B. Leedy, Laurence D. Simmons, Barthelmes, and G. H. Westby.

Officers reelected include Westby as president; J. E. Hawkins, vice president; R. W. Mossman and R. B. Baum, assistant vice presidents; F. B. Leedy, treasurer; J. L. Hull, Jr., secretary and general counsel, and W. H. Van Horn, assistant secretary.

Oilwell Makes Stanley Sales Head, Neilsen Pump

W. C. STANLEY

Walter C. Stanley has been named sales manager of Neilsen Pump Works of U.S. Steel's Oil Well Supply Division, R. K. Baker, manager of Neilsen Pump Works, has announced. Neilsen Pump, a major producer of oilfield subsurface pumps, is located in Long Beach. Stanley, who has served as district manager at Long Beach since 1943, will continue to be headquartered at the plant.

Stanley joined "Oilwell" in 1937 at Neilsen Pump. He subsequently served as field representative at Long Beach and at Huntington Beach before becoming district manager at Long Beach.

Truck-Cranes Shipped to Indonesia Oil Fields

Evidence of the increasing oil activity in Indonesia is the recent shipment of two Hydra-Lift truck-cranes, built by Pitman Manufacturing Co., to that country. These are used primarily for hauling and lifting steel pipe.

The cranes, mounted on G.M.C. truck-tractors, were bought by Standard-Vacuum Oil Co. The transaction was handled by Robert H. Reynolds, president of Rocky Mountain Export Co. of Denver, Colo.

The truck-cranes were driven to New Orleans and placed on board the S.S. Polyphemus. Two more G.M.C. truck-tractors, without Hydra-Lift cranes, were loaded on the same ship at another port for the same destination.

McMurry and Brown Form Oil-Tool Organization

E. D. McMURRY

H. L. BROWN

E. D. McMurry and Harold L. Brown have recently formed McMurry-Brown, Inc., an oil-tool manufacturing and sales organization with headquarters in Houston.

The firm is now manufacturing a complete line of gas lifts, plunger lifts, and surface controllers. Other items are now being developed and will be announced.

Sales and service points are being established at Oklahoma City; Hobbs, N. M.; Odessa, Abilene, Tyler, Victoria, and Corpus Christi, Tex.; and Shreveport, Lafayette, and Harvey, La.

Both McMurry and Brown were vice presidents of Garrett Oil Tools before forming the present organization.

Dowell Approves Research Laboratory Addition

At a Dowell directors' meeting, plans were approved for adding 12,600 sq. ft. of floor space to the research laboratory located in Tulsa. The announcement of the plans for expanding Dowell's research facilities was made by A. C. Polk, vice president and general manager, and Dr. W. W. Love, director of research.

An additional 1,450 sq. ft. of floor space in the equipment assembly building will also be acquired for studying chemical batching and mixing of materials. "The present laboratory is less than 2 years old, but due to the company's growth during the last few years and the expansion into new oil field and industrial services, more room is required for research and technical-service activities," Polk said.

The additional space will be used for organic and physical - inorganic research. Facilities will be provided in the new building for radioactivity processing and research. The technical library, housed in the present building, will also be enlarged.

Plans for adding to the instrument section are under consideration. This department now includes X-ray diffraction, emission spectograph, infrared spectrometer, metallograph, and other scientific equipment used by the company in its research and technical services. Future programs include the addition of an electron microscope, X-

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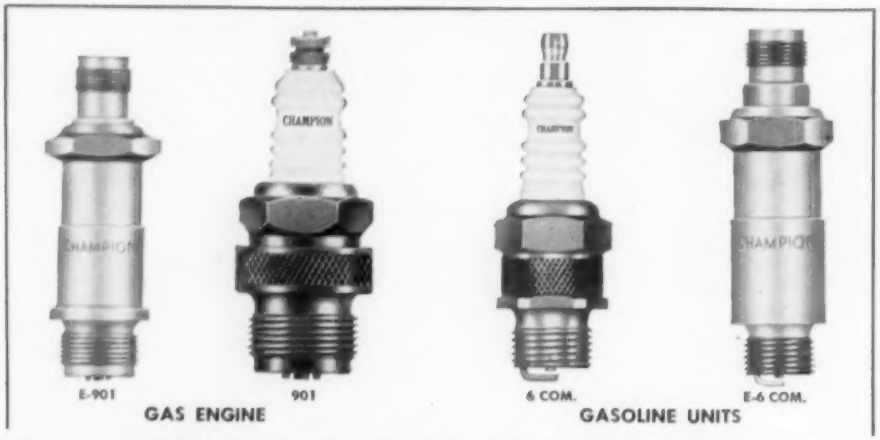

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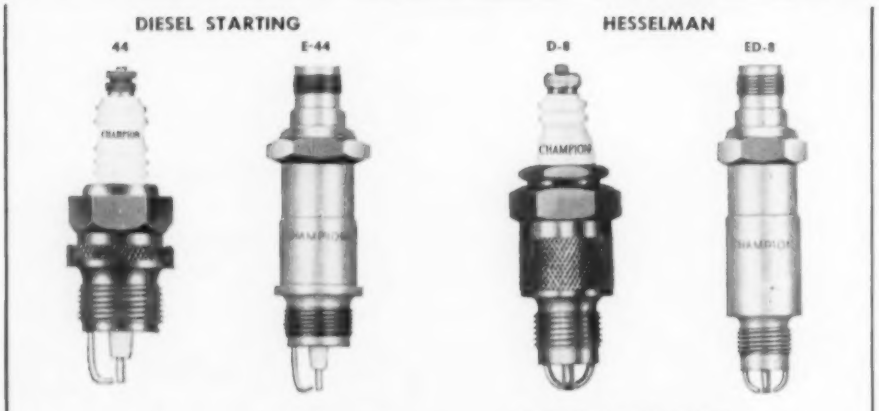

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CHAMPION

SPARK PLUGS

CHAMPION SPARK PLUG COMPANY, TOLEDO 1, OHIO

ray fluorescence analyzer, and a mass spectrometer, according to Dr. R. B. Rosene, Dowell laboratory director.

Lee Named District Sales Head in Salem for BS&B

JIMMY LEE

Black, Sivalls & Bryson, Inc., announces the appointment of Jimmy Lee as district sales manager for BS&B's newly created Salem, Ill., district. Floyd Myers, manager of oil-field sales and service, made the announcement. Lee has been with BS&B for the past 8 years. He started as a salesman at Elk City, Okla., and later served at Oklahoma City. In 1952 he was promoted to manager of the company's branch at Snyder, Tex. Later he was appointed senior salesman at Snyder to devote full time to selling activities.

In his new position, Lee will be responsible for oil-field-equipment sales in the Tri-State (Illinois-Indiana-Kentucky) and Michigan oil-producing areas.

Foxboro Announces Sales Management Appointments

The appointments of C. C. Fuller as vice president, augmenting the sales management staff; H. O. Ehrisman as general sales manager; and J. J. Burnett

C. C. FULLER

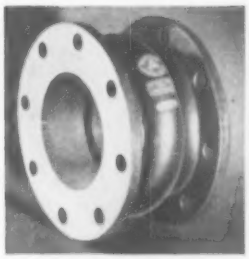
H. O. EHRISMAN

as field sales manager, have been announced by R. A. Bristol, director in charge of over-all sales activities of The Foxboro Co., Foxboro, Mass.

C. Schwarzler will continue to direct Foxboro's expanding international activities. Vice President C. E. Sullivan, who has retired from active sales direction, will serve in a consulting capacity with the sales organization.

Also announced was the formation of a sales-product-development committee headed by Fuller and a sales-policy committee with Ehrisman as chairman.

Fuller joined the company in 1920 and was assigned to the New York office as sales engineer. In 1930 he be-

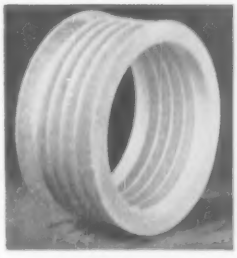


Spool-type
Rubber Expansion Joint

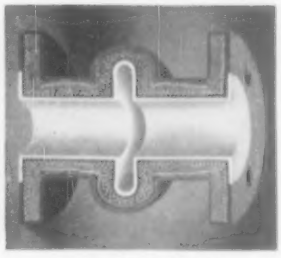
Rectangular-type
Rubber Expansion Joint

U-type
Rubber Expansion Joint

There's a GARLOCK EXPANSION JOINT for your piping applications



All-Teflon*
Expansion Joint



Rubber Expansion Joint
with Teflon liner

Expansion Joint for use on
Haveg and Duriron piping

- **To stop vibration, flange breakage**
- **To relieve stresses and strains in piping and equipment**

Garlock manufactures a *complete* line of expansion joints specifically designed to meet the requirements of different types of service. **Rubber Expansion Joints** are made in all pipe sizes from ¾" to 72" for water, air, or exhaust steam. They are furnished in round, rectangular, tapered or offset; spool-type and U-type.

All "Teflon" Joints or **Rubber Joints with Teflon liner** are made for chemical service; **Neoprene Joints** for oil service. Specially designed Rubber Expansion Joints are now available for use on piping and flanges made by **Haveg Corp.** and **The Duriron Co., Inc.**

Write today for Expansion Joint Folder AD-137.

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In Plants of Modern Design

PROVE THIS FURNACE

Most Efficient By Any Comparison

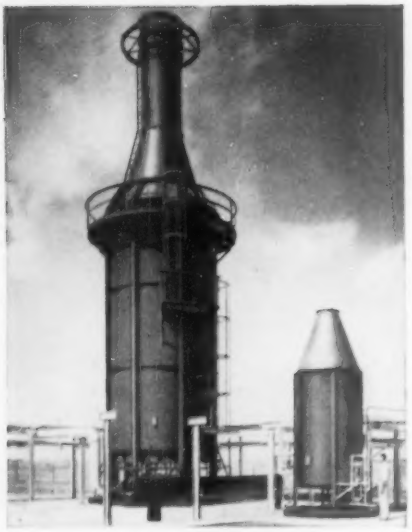
. . . . . for refiners using catalytic processes including: cracking, reforming, alkylation, polymerization, isomerization, desulfurization, hydrogenation and dehydrogenation.

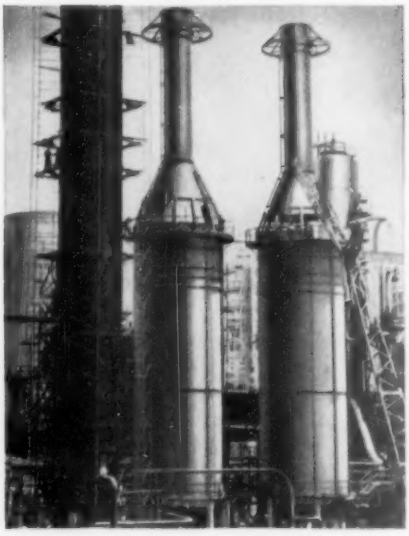
PETROCHEM-ISOFLOW FURNACES are Unlimited in Size . . . Capacity . . . Duty from 100,000 to 250,000,000 BTU PER HOUR

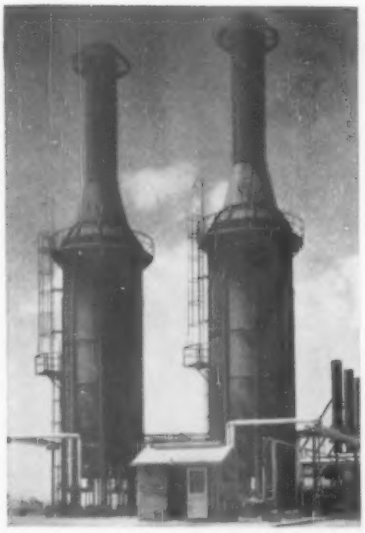
These are the 11 all-important factors which determine the value and efficiency of processing furnaces:

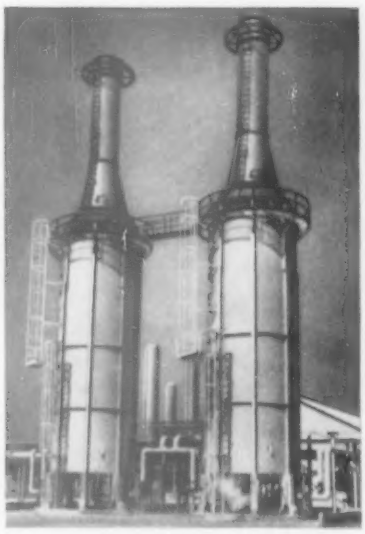
UNIFORM HEAT DISTRIBUTION
MAXIMUN FUEL EFFICIENCY
PLENUM CHAMBERS FOR HAZARDOUS AREAS
SIMPLICITY OF DESIGN AND CONSTRUCTION
EXCESS DRAFT FOR HIGH OVERLOAD
EXPLOSION RESISTANT
MINIMUM GROUND SPACE
SHORT LENGTH OF LIQUID TRAVEL
ZERO AIR LEAKAGE
LOW PRESSURE DROP
LOW MAINTENANCE

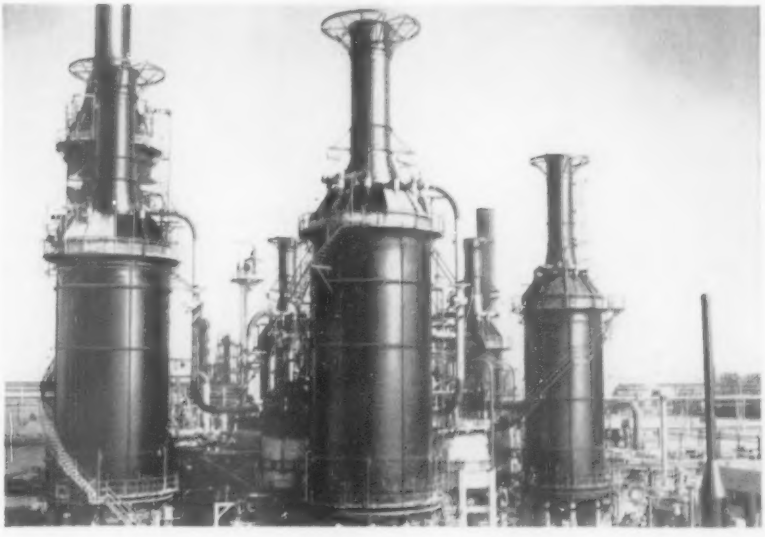
In every case where these 11 all-important design characteristics were employed to compare one type of furnace design with another, PETROCHEM-ISOFLOW FURNACES were proved most efficient by any comparison.

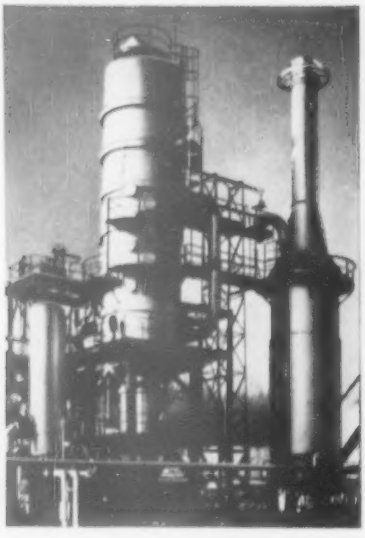


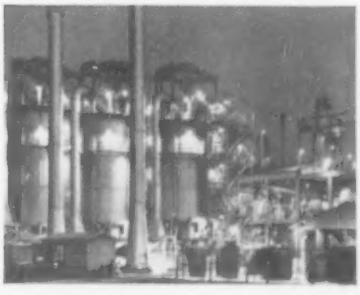












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HUMBLE OIL & REFINING CO.

came manager of the New York branch and 9 years later was named division manager. Since 1941 he has served as assistant general sales manager.

Ehrisman joined the firm in 1936. Later he became manager of instrument sales in the pulp and paper, rubber, and textile industries. In 1954 he was appointed manager of sales promotion, and in 1949, assistant general sales manager.

Burnett, who will have general supervision over Foxboro's 48 branch offices, has been with the company since 1925. He served successively as sales engineer, Chicago branch manager, and manager of the Central division.

Southern Geophysical Names Upshaw Head of New Division

R. W. UPSHAW

Southern Geophysical Co. of Fort Worth has opened a Gulf Coast division office at New Orleans, La. Raleigh W. Upshaw, newly appointed vice president, will be in charge, according to company president, Dr. Sidon Harris.

Upshaw has been active in seismograph operations for the past 18 years. More than half of his experience has been connected with seismic operations in southern Louisiana. Before joining Southern recently, Upshaw had been a consulting geologist in New Orleans. Prior to that, he had been connected in various capacities with several major contracting geophysical companies, including a 4-year stay in Mexico.

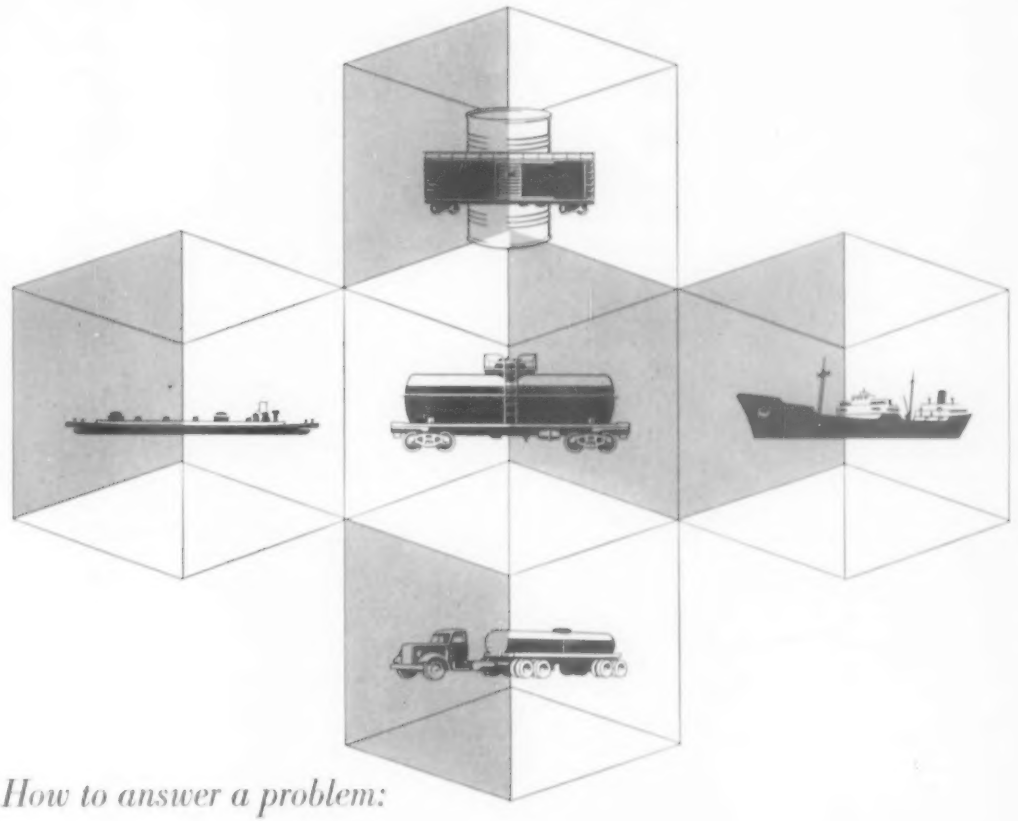
White Motor Gets National Supply's Engine Division

W. F. BURROWS

White Motor Co., Cleveland, has formally acquired the engine division of the National Supply Co. in Springfield, Ohio. The transfer of property was made last month. It marks White Motor's entrance in the diesel-engine industry with a well-established and modern subsidiary that is widely known as the producer of Superior and Atlas engines.

Robert F. Black, president of White, announced the appointment of William F. Burrows as general manager of the newly acquired division which is to be known as the White Diesel Engine Division. He also announced the appoint-

DOW



How to answer a problem:

there's *no illusion* to what you get when your CAUSTIC comes from DOW

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There's one simple, across-the-board answer to any caustic soda problem you might have: *Get it from Dow!* Dow has the *form* you need: ground flake, flake, solid, 50% or 73% solution. Dow *makes delivery* by the most economical "package": tank car, tank truck, barge or ocean tanker.

Dow's Alkali Sales Department will gladly look into the economics of *your* caustic use . . . and may well be able to point out surprising *savings*. So many services are yours—*dependably* yours—when you deal with Dow. THE DOW CHEMICAL COMPANY, Dept. AL 3606, Midland, Michigan.

you can depend on DOW CHEMICALS

DOW

ment of William H. Johnson as division controller, and R. E. Lavery as assistant in the formulation of policies and procedures.

Schlumberger Names G. D. Rosel Field Sales Engineer

Schlumberger Well Surveying Corp. has announced the appointment of G. D. Rosel as field sales engineer for the Kansas division.

Rosel will have his headquarters at Wichita. He was formerly a field engineer for Schlumberger at Independence, Kans.

Darling-Kenady Organized As Manufacturer's Rep's.

Establishment of Darling-Kenady Co. in Denver as manufacturers' representatives specializing in oil-industry equipment has been announced by R. A. (Bud) Darling and Melvin S. (Mel) Kenady.

R. A. DARLING

M. S. KENADY

Darling and Kenady were associated with the Tulsa branch of Cooper-Bessemer Corp. as sales engineers before the establishment of their own offices in Denver.

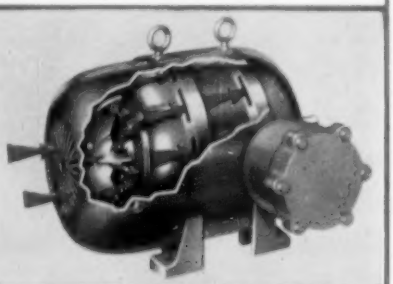
Lines represented by the firm include Burgess-Manning, Berry, Cook, Smithco, Stitt, and Union Steam products. Territory covered embraces the greater portion of the Rocky Mountain region with special emphasis placed on service to the gas, gasoline, and refining industries.

To petroleum engineers, Howell suggests

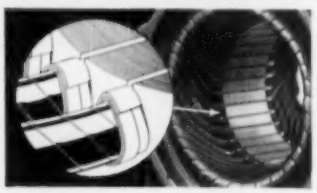
What to look for in explosion-proof motors

Beyond an enclosure for containing an internal explosion effectively, you want the most dependable and lasting motor you can get. Below are some points for comparison . . . and a few of the many "bonus" features of Type EK Howell motors. They're made in sizes from ½ to 50 h.p.

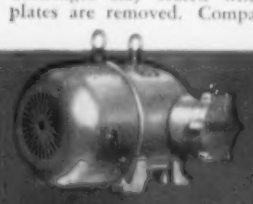
VENTILATION. "Cool running" means long life in motors. Fan-forced air moves through continuous passages between stator and frame of a Howell Type EK motor. Heat is removed before it can build up and cause injury to windings or ignite explosive gases. Compare!



BEARINGS. When they're fully protected, wear is negligible. Dust can't enter Howell's cartridge-type, double shielded bearings either from inside or outside the motor. Cartridges stay sealed when end plates are removed. Compare!



INSULATION. Hidden values here! Note Howell's stator slot insulation, with Mylar®-lined slot cells "cuffed" for extra protection. Two cycles of varnish impregnation and baking protect windings against moisture, oil, and fumes. Compare!



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RUGGED, TIGHT CONSTRUCTION!
Howell explosion-proof motors have cast iron frames and end plates, machined for precision fit.

WRITE FOR BULLETIN EK-2

HOWELL MOTORS

Howell Electric Motors Company, Howell, Michigan

PRECISION-BUILT MOTORS FOR INDUSTRY SINCE 1915

HOWELL Red Band MOTORS

Dewey Supply Opens Stores In Okemah and Chickasha

Dewey Supply Co., Tulsa, has announced the opening of two new stores in Okemah and Chickasha, Okla.

The Okemah store will be managed by Vern Ragan, with George Coleman serving as fieldman and J. D. Walker serving as floorman and pump repair man.

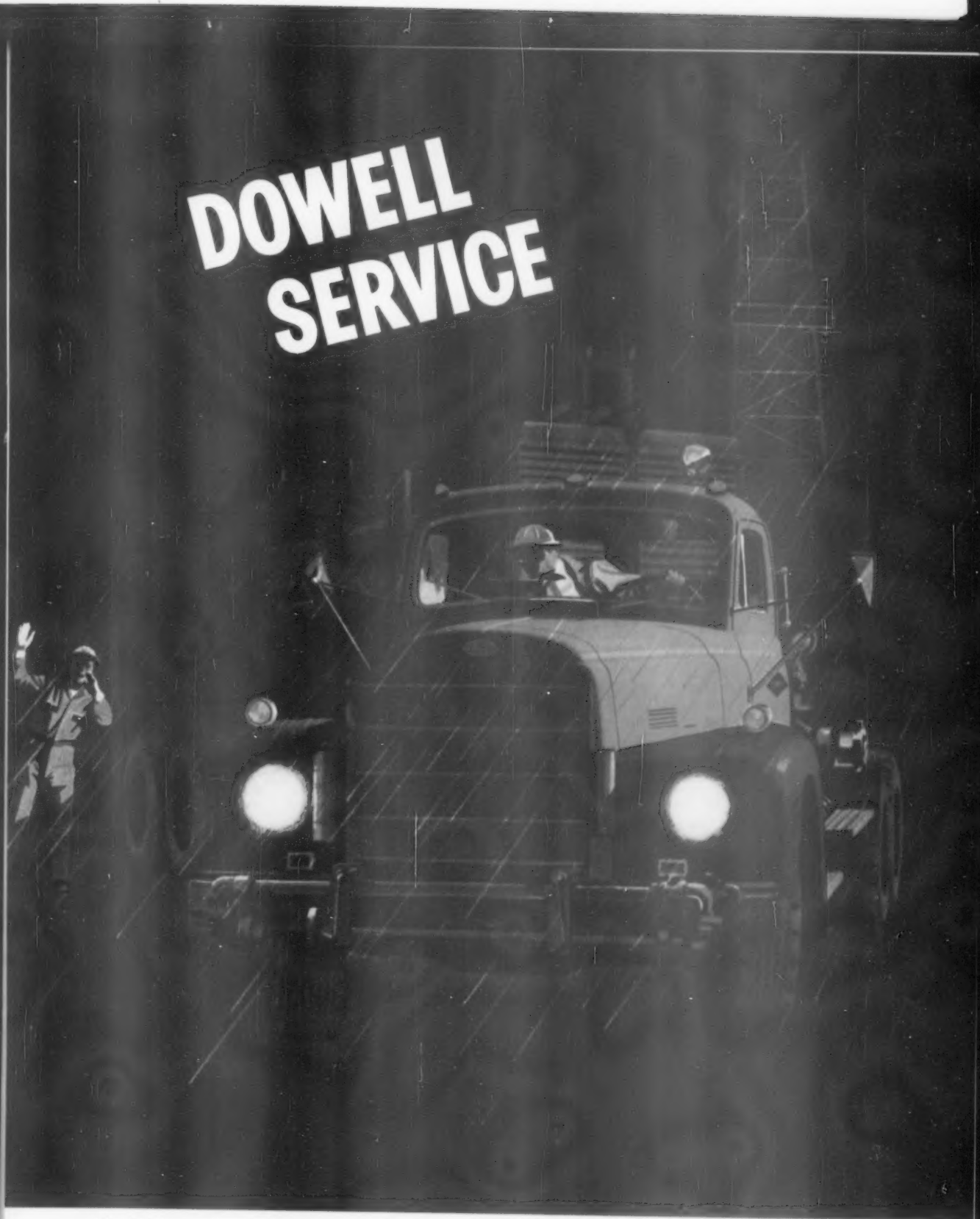
In Chickasha, Doug Evans has been appointed acting store manager, with Walter Ware, fieldman, and Jack Baker, floorman. Dewey Supply also has stores located in Ada and Dewey, Okla.

Nelson Electric Completes Annual Sales Conference

Sales engineers from the United States, England, and Puerto Rico were briefed on newest developments in the field of oil-field electrical equipment at sales conference sessions held by Nelson Electric Manufacturing Co., Tulsa.

Hans Norberg, vice president and general manager, outlined projects now under way in the firm's research and development laboratories, and dis-

Sales engineers inspecting this new oil-field motor starter in the accompanying photo are: Bill Norvell, one of the Nelson design engineers who helped develop the starter; Marshall Gettys, Houston; Ernest Gardner, Charlotte, N. C.; and Bill Adair, Dallas.



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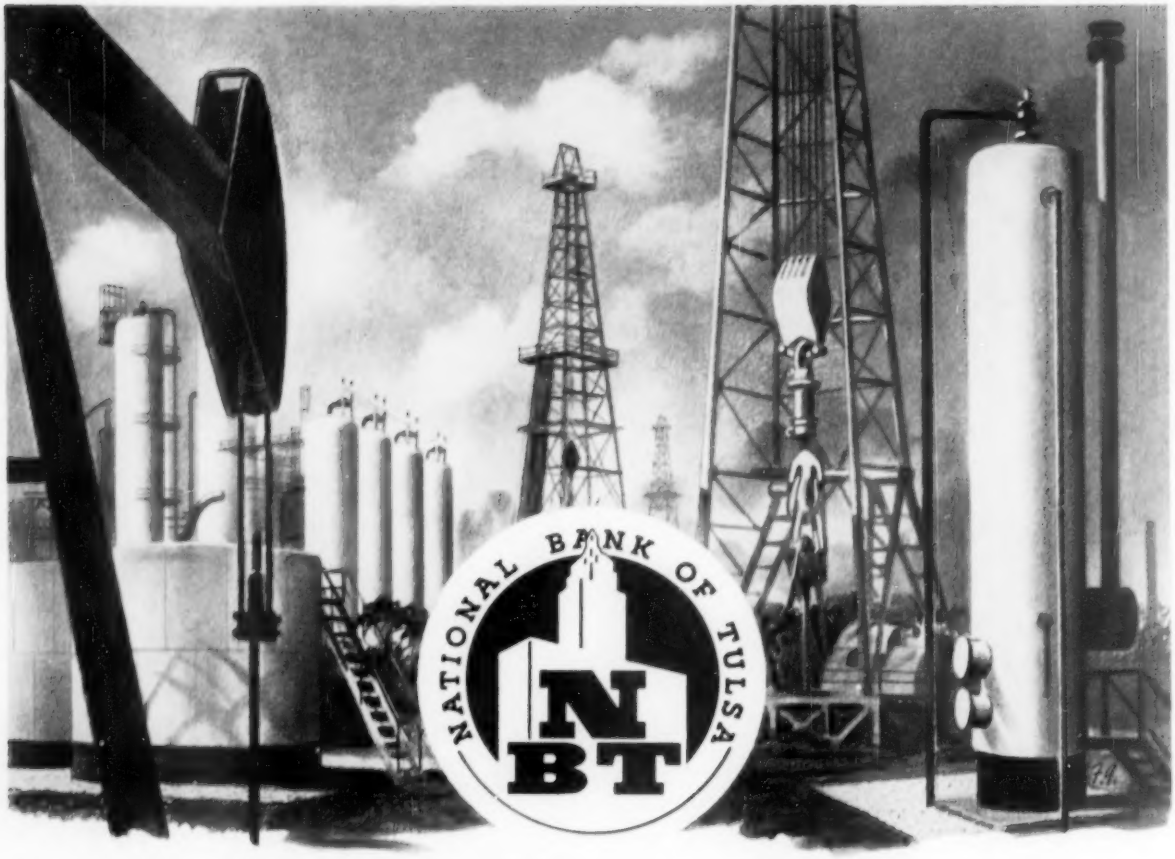
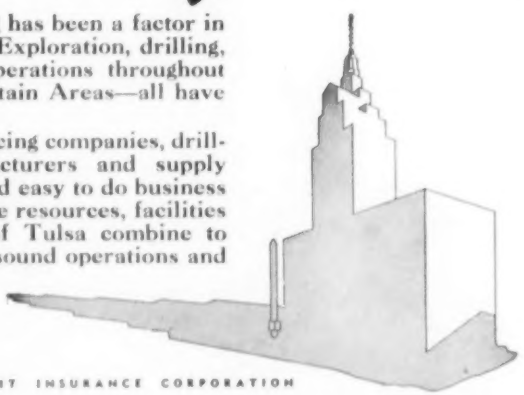


IN WHATEVER PHASE OF OIL...

See *The Oil Bank of America*

National Bank of Tulsa financing has been a factor in the development of the oil industry. Exploration, drilling, producing, refining and pipe line operations throughout the Mid-Continent and Rocky Mountain Areas—all have benefited.

Independent operators and producing companies, drilling contractors, equipment manufacturers and supply firms find it profitable, convenient and easy to do business with "The Oil Bank of America." The resources, facilities and experience of National Bank of Tulsa combine to meet every practical requirement of sound operations and new developments.



MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

NATIONAL BANK OF TULSA

The Oil Bank of America

OFFERING COMPLETE BANKING AND TRUST SERVICES

closed projects being considered for the future.

The sessions were attended by 60 sales engineers. Highlights of the 4-day conference included: (1) tours of the company's new plant site in Tulsa where construction of a new factory and office building will begin soon; (2) round-table discussions of sales problems; (3) reviews of the economic outlook of the industry and the nation; (4) presentation of sales-promotion techniques; (5) sales film presentations; and (6) social functions.

Nelson Electric unveiled its soon-to-be-offered oil-field motor starter.

Patterson Named Assistant To Failing President

PATTERSON

K. W. Patterson of Tulsa has been appointed to the position of assistant to the president of George E. Failing Co., Enid, Okla., manufacturers of portable drilling rigs. Patterson's appointment was announced by Paul Courtney, president of Failing.

For the past 2 years, Patterson has been with Unit Rig & Equipment Co. of Tulsa as first assistant to the president and vice president in charge of manufacturing. Before that, he was employed by the Beech Aircraft Corp. as project planner; with the Globe Aircraft Corp. as production manager; with the Wichita Engineering Co. as project manager and assistant to the president; with the Texomatic Tool Co. as production engineer; and with Emsco Manufacturing Co. as production manager and administrative coordinator.

New Firm Organized for Pipeline X-Ray Service

Pipeline X-Ray Service has been formed from within pipeline management, employes, and equipment of Richardson X-Ray Service, to operate internationally, and in all states of the U.S. except California. The new company, still associated with Richardson, has just recently been awarded a contract in Spain to X-ray the POL pipeline to U.S. air bases between Cadiz and Saragosa. C. W. Radcliff is vice president and general manager of the company with offices in Houston. Field superintendents are H. E. Smith and Earl Watson.

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for high efficiency gas purification at high pressures

Iron Sponge is your key to sulfur-free gas at minimum processing cost. Iron Sponge has high efficiency at low pressure or at today's high pressures and high temperatures. It absorbs *more* H_2S, gives long service between foulings, and is easily regenerated. Investigate it for your purification problem today!

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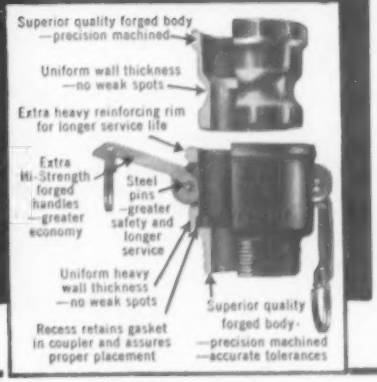
It pays to get EVER-TITE *Quality* in Quick Couplings

There's an EVER-TITE for every need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Uniform wall thickness —no weak spots
Extra heavy reinforcing rim for longer service life
Extra Hi-Strength forged handles —greater economy
Steel pins —greater safety and longer service
Uniform heavy wall thickness —no weak spots
Recess retains gasket in coupler and assures proper placement
Superior quality forged body —precision machined —accurate tolerances

EVER-TITE Couplings give you a quick, tight connection every time—under every condition. They make your deliveries fast . . . safe . . . dependable. Ever-Tite Couplings are manufactured of stainless steel, bronze, aluminum, steel and malleable iron.

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OVER
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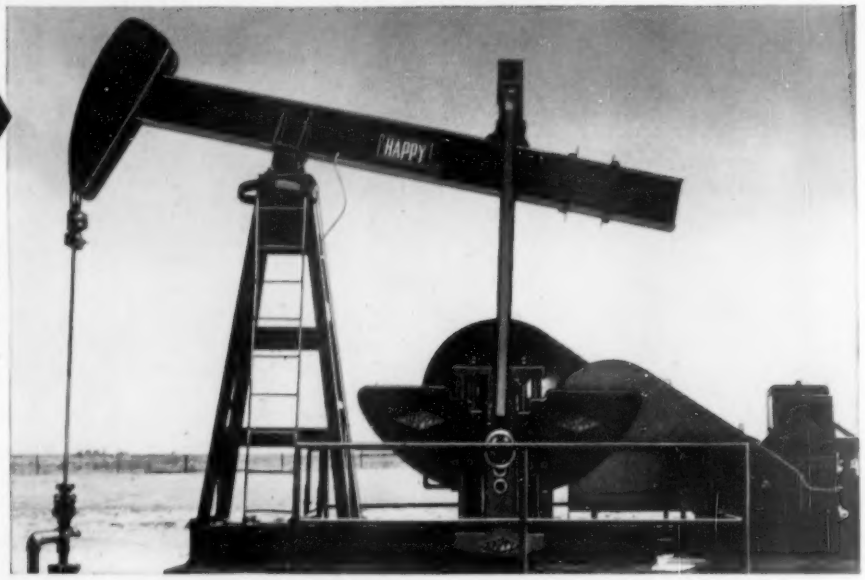
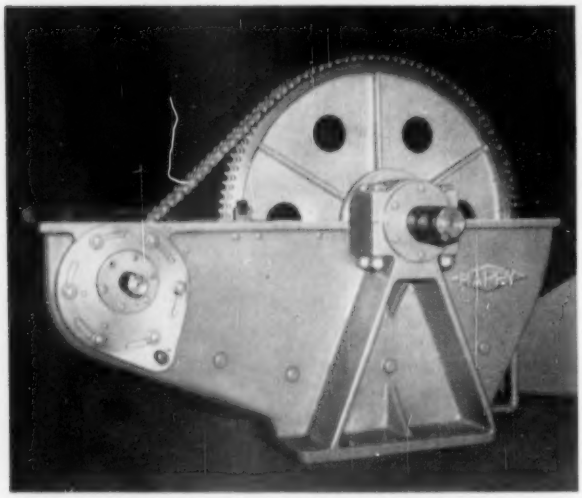
STROKES
PER WEEK—



HAPPY USES DIAMOND ROLLER CHAIN DRIVES



Exclusive Happy Flexdrive High Ratio Reducer uses triple ¾" pitch Diamond Roller Chain. Flexibility of drive assures more production, easier operation and less rod trouble.

Here there can be no substitute for quality—for under continuous week-in and week-out pumping, only the finest of materials and components can meet the severe demands.

As on the earliest Happy Pumpers, the latest models are equipped with dependable Diamond Roller Chain drives. They provide nearly 100% efficiency throughout their entire life and promote easier rolling so that less input horsepower is required to do any specific pumping job. Diamond Roller Chains' *uniform* highest quality assures the dependable long-life operation Happy demands.

When you want Roller Chain, it will pay you to specify Diamond.

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For many, many years, Diamond Chain has been preloaded after assembly for the purpose of bringing pin-bushing seating into stabilized relationship prior to field installation.

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DIAMOND ROLLER CHAINS

New Approaches May Find Florida's Oil

by Frank J. Gardner

FLORIDA is an enigma. A challenge. A tease. Florida is a frontier, a promise, and a gleam in the eye of her lessees. For 50 years, she has tempted the oil hunter, tantalized him with hope, and frustrated him with disappointment. Two small fields are his only reward.

Florida doesn't yield her subsurface secrets easily. From the first, the search for oil has been plagued with obstacles, on the surface and below it. There are few surface outcrops, forbidding problems of terrain, and buried barriers to drilling and seismic shooting. So for the first few years, exploration was blind.

New methods . . . Now the picture is changing. Enough holes have been drilled to supply at least a beginning picture of the subsurface. Regional geology is better understood as samples and cores are analyzed and correlated. New kinds of transport can conquer mean terrain. Defiant drilling crews pierce thick sections with no returns in the pit. And seismic teams have won their fight with high-velocity close-to-surface beds by refraction instead of reflection attack.

There is a general feeling that "Florida's oil lies deep." This isn't necessarily so, for if any region offers diverse prospects, this is it. The broad Ocala uplift in the northern half of the peninsula holds hope for production above 5,000 ft. The panhandle in the west is hot with promise of faulted traps along the Pollard trend. And the swampy Everglades and offshore keys are potent targets for the real deep oil.

Of the three areas, and based on what we know of the buried rocks to date, the **best** expectations should lie between the Everglades and the uplift. This is "independent country," unlike the southern basin where only a major company is likely to gamble a pot of money for a questionable stake. Using the newer concepts of seismic search, and the same derring-do in drilling, it is not unlikely that new and shallower (and possibly prolific) pools will be discovered in the wedge-out belt of Lower Cretaceous rocks as they sweep upward toward the Ocala arch.

And new knowledge . . . But since 1939, the year of Florida's most significant wildcat, oil hunters have been afflicted with the "depth" complex. That wildcat, Peninsula Oil Co. 1 Corey (D on map), was indeed the turning point in Florida exploration for it was the first to record accurately the complete sequence of beds, the first to reach 10,000 ft., and the first to penetrate more than 4,250 ft. of Cretaceous carbonates, thereby proving the existence of a Cretaceous basin in the south. Using the refraction techniques, geophysicists now postulate a 30,000-ft. section of nonclastic sediments for that basin.

Geologists hope to isolate many dip reversals, anticlines, and possible faults in these buried Cretaceous rocks, and the possibility of strat traps is not ignored, especially beneath the unconformity which separates the Upper and Lower Cretaceous sections. Northward, toward the Ocala uplift, the Upper Cretaceous beds overlap the Lower Cretaceous section (absent on the uplift). The oil hunter who finds the wedge-out fields should be rewarded with a bonanza, for some of the world's best oil fields have flowed from the Lower Cretaceous limestones.

Can find new fields . . . For the moment, however, attention is concentrated on two new "offshore" tests. Both will go deep in a search for the Sunniland (Glen Rose) limestone. Both are located on information supplied by the latest seismic and subsurface techniques. And either could open new tidelands fields for Florida.

In Barnes Sound, west of Key Largo, Commonwealth Oil Co. 1 State 362 (11-60s-39e) will probe a new flank of an old seismic prospect with at least 400 ft. of closure, and trending northeast - southwest through the Key Largo area. It lies southwest of two deep failures on the same trend, Sinclair Oil Co. 1 Williams (A on map) and Republic-Robinson 1 State (B on map). Both these dry holes had teasing shows of oil below 10,000 ft. in the Sunniland limestone.

Gulf Oil Corp. 1 State 826-G (unsurveyed block), at the southwestern tip of the peninsula, will test to 12,500 ft. between the keys and the mainland in Florida Bay. It lies 35 miles northeast of Gulf's 1 Scranton-State, on Big Pine Key (C on map), deepest well in Florida with total depth of 15,455 ft. and Gulf's 1 State 374 on Sugar Loaf Key (F on map), most southerly well drilled in the United States.

With these three deep tests in the south, Gulf, Commonwealth, and Humble hope to solve one more puzzle in the challenge of Florida. If they fail, the dogged determination displayed so far in the peninsula probing will no doubt lead to other later tests, for Gulf Coast geologists are convinced that Florida holds more potential promise than any other domestic frontier at the moment. It is indeed a challenge.

Three deep wildcats, all projected to 12,000 ft. or more, will try for new Florida fields. Letters indicate earlier deep failures.

Fig. 1.

Here's a brief report that explains

Why South Louisiana Lures Heavy Play

by Norman S. Morrisey
Drilling-Development Editor

WHY are oil companies increasing their exploration efforts in South Louisiana?

The answer is simple: Rich reserves, drillable prospects, a fast payout on investments, and a better-than-average chance of finding production.

South Louisiana is a good spot to look for oil. In the first quarter of 1955, there were 51 successful exploratory tests and only 51 dry exploratory holes for a 50 per cent success record.

Exploration in South Louisiana is on the upsurge and will probably surpass 1954. South Louisiana is one of the few major provinces to show a marked increase in seismic activity during the past 24 months. Today over 100 crews are looking for new prospects; only 68 crews were active 2 years ago.

Miocene . . . Although several trends produce in southern Louisiana, large operators concentrate on the prolific Miocene sands (Fig. 1). On this trend, reserves of 50,000 bbl. per acre are not uncommon and engineers estimate reserves based on recoveries of as much as 800-1,000 bbl. per acre-foot of pay sand.

Salt water on a drill-stem test does not condemn deeper sands. Overlying zones may yield water, but experience has shown that underlying sands may produce. In several fields producing zone occurs between water-bearing sands.

The thickness of the Miocene ranges from a few hundred feet in the vicinity of Baton Rouge to over 20,000 ft. at the tip of the Mississippi delta.

Miocene sediments consist of highly porous and permeable unconsolidated sands separated by shale. Net pay thicknesses range from 10 ft. or less to over 800 ft.; the sands are often lenticular.

Offshore drilling has shown that a thick Miocene section is present; Magnolia Petroleum Co. has completed several wells in its Block 126 field with over 800 ft. of net productive sand.

Geologists and engineers speak in glowing terms of the Miocene sands. Most of the fields have an active water drive, and the average pay thickness is roughly 150 ft. Recoveries are high. In isolated instances they may approach 1,400 bbl. per acre-foot of sand. This figure contrasts sharply with 75-100 bbl. per acre-foot, for the Ellenburger and 150-200 bbl. for some of Oklahoma's Pennsylvanian sands.

Oligocene trend . . . Updip from the Miocene lies the Oligocene trend. These sands, although prolific, are not as attractive a target as the Miocene. Recoveries from the Frio sands are on the order of 600 bbl. per acre-foot which by most standards is a very worthwhile objective.

The Frio sands lie along an east-west belt in the vicinity of Baton Rouge and Lake Charles. East of Baton Rouge, the sands become calcareous and only account for minor production. The formation continues west and southwest into Texas where it is a very important oil-bearing zone.

Reef limestones may occur in the Oligocene, especially in the vicinity of Lake Pontchartrain. Some geologists, however, do not consider that these limestones are reefoid in character.

Wilcox trend . . . North of the Frio trend is the Wilcox production. Although there are many fields producing from the Wilcox, oil companies do not concentrate on this trend as they do on the Miocene and Frio trends to the south.

The structures are small, the sands very erratic, and the Wilcox structures

are difficult to map with the seismograph.

Regional Geology

South Louisiana is a broad homocline. The sediments dip toward the Gulf of Mexico at a fairly uniform rate of about 150 ft. per mile. Actually this homocline extends into Texas and forms a narrow arcuate belt 700 miles long and 140 miles wide.

The sediments are principally sands and shales deposited during Cenozoic time. Although Cretaceous and Mesozoic beds may underlie the entire area, they have not been penetrated except for the salt. It is considered to be equivalent to the Louann salt of North Louisiana and South Arkansas and has only been drilled on the salt domes.

The regional strike is essentially east-west, and the dip is toward the gulf. Progressively younger beds outcrop as the gulf is approached.

Geologists consider that all the Cenozoic clays, sands, and shales have a similar origin. Southward-flowing rivers, similar to those of the Gulf Coast today, brought clastic material, silt, and clays from the center of the continent. These sediments were deposited on flood and coastal plains over the entire area. The seas alternately invaded and retreated during deposition, and these marine invasions account for many of the variations in lithology, both local and regional. Thus continental and marine sediments interfinger over much of the geologic column. This transition zone migrated southward from Eocene to Pleistocene.

The "fairways" or productive trends (Fig. 1) normally occur on the seaward side of the transition zone between the continental and marine facies. (See A.A.P.G.-S.E.G.-S.E.P.M. Guide Book, joint annual meeting, Houston, March 1953.)

The various lithologic units thicken in a gulfward direction at a fairly constant rate. Although the major transgressions of the sea can be recognized over wide areas, local breaks make correlations exceedingly difficult, especially within the Miocene. But the presence of these local unconformities increases the possibilities for oil accumulation.

Structure . . . The major structural feature of South Louisiana is the homocline or southward-dipping sediments that form the north limb of the Gulf Coast geosyncline. Superimposed on this homocline are several structural features which are regional in extent. Along the rim of the salt basin, fault trends occur that parallel the regional strike. These faults extend for miles in the subsurface and are a major factor in controlling Oligocene production.

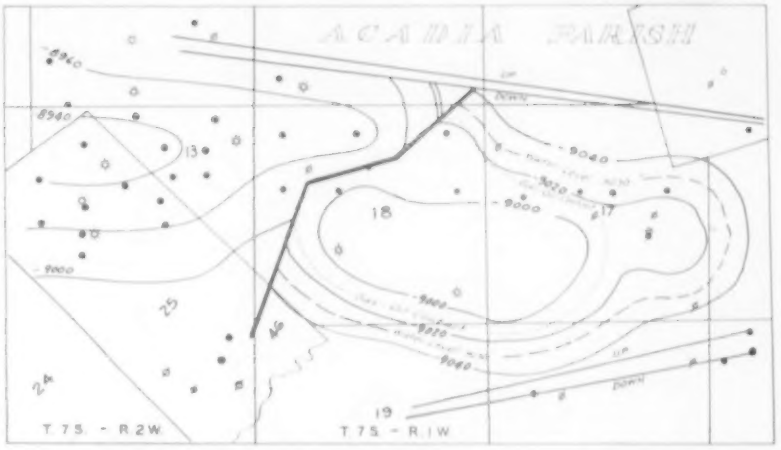

Fig. 2—Along the Oligocene trend, faulting plays a key role in trapping oil.

Salt features . . . Apart from the fault trends, salt movement is the dominant structural factor in forming oil fields. And some geologists consider that even the fault trends were formed by salt movement.

Salt domes form a wide variety of traps and account for most of South Louisiana's production. In the past the terms piercement and deep-seated domes have been used. But these terms are falling into disuse because some geologists consider that all salt domes are actually piercement type, whether wells have reached the salt or not. Many Gulf Coast geologists divide salt domes into two main classes: shallow, where the caprock or salt has been found above 5,000 ft., and deep-seated, where dome material is below 5,000 ft. Others prefer a more detailed breakdown.

Salt-dome geology is exceedingly complex. Uplift of the salt has caused complicated fault patterns, abnormal structural relationships, and overhang on many domes.

The Five Islands in South Louisiana are shallow domes that stand well above the surrounding marshlands. This chain of salt domes extends from Jefferson Island on the north to Belle Isle on the south. They form a pronounced structural feature called the Five Island syncline because of the regional depression on the flanks of the domes. As a matter of fact, many salt domes have local depressions associated with them, depressions which may be due to removal of salt and subsequent slump of the sediments. A local depression that encircles a salt dome is termed a rim syncline.

Faulting on the salt domes is of the normal or gravity type. The dip of the fault plane ranges from 45° to 60°. Drilling shows that the uplift of the salt may affect a wide area surrounding the salt. Thus even today oil companies are finding new production on the flanks of the old known shallow domes.

Deep-seated domes . . . Prolific production is found on the deep-seated domes which are the cream of the Gulf Coast. These domes have a typical fault pattern and many of them are apparent as gravity anomalies. Bateman Lake, Lafitte, Horseshoe Bayou, and Bayou Sale are only a few of South Louisiana's deep-seated domes (see A.A.P.G. Bull., September 1944).

Fault trends . . . The Tepetate trend extends for nearly 100 miles and consists of an east-west trending fault system. The faults controlling production are normal or gravity-type faults with the downthrown side toward the coast. Oil is found on the south side of these down-to-the-coast faults. The trend is not a single fault, but is a series of faults or fault zones. A similar trend occurs in Beauregard Parish and controls Cockfield and Wilcox production.

Oil accumulation is controlled by closure against the downthrown side of the fault. Frequently the beds dip into the fault to form a low-relief faulted anticline. North Tepetate (Fig. 2) is an excellent example of this type of trap.

Stratigraphic traps . . . Strat traps will be an important future source of oil in South Louisiana. Oil companies, however, are not concentrating their efforts on finding this type of production. Salt structures and fault prospects are still the primary goal.

This is actually an encouraging sign, for geologists look for strat traps when they have exhausted the structural possibilities of an area. Geological data indicate clearly that stratigraphic plays should exist. It is simply a question of finding them.

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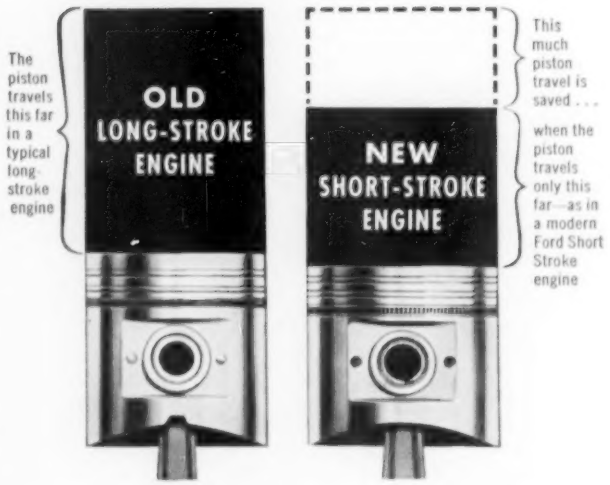
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EXPLORATION HIGHLIGHTS

MID-CONTINENT

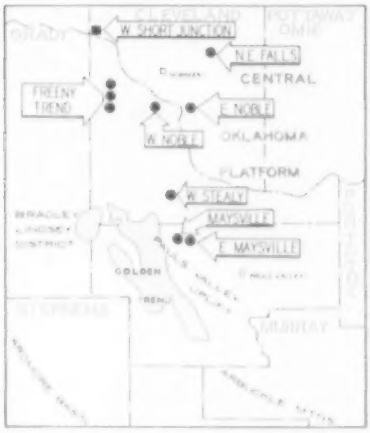
OKLAHOMA

Seismic Work Up in Various State Areas

Geophysical work in Oklahoma is taking big strides in southern, central, and northern counties.

Companies have had considerable success in the past few years in mapping the Simpson micro-structures in Garvin, McClain, and Cleveland counties. Further successes are anticipated in future months. Fields, though relatively small in areal extent, are prolific and make attractive drilling prospects. Some of the good pools found in the past few years as a result of extensive seismic work in south-central Oklahoma are: Maysville, East Maysville, West Short Junction, West Noble, West Helsel, Northeast Falls, the Freeny trend, West Stealy, and East Noble.

Current activity . . . Superior Oil Co. has spread its seismic work throughout Oklahoma. The company is engaged in peak geophysical work. The firm has an extensive seismic program in Coal County with long base lines established through a number of townships after 2 months of work. The exploration is centered in 2n-8e, covering about 90,000 acres. This county has been covered extensively in the past 6 years by Stanolind, The Texas Co., and others.



Here are some of the recent discoveries in south-central Oklahoma based on geophysical exploration.

Norman . . . Superior has also been busy in the competitive Norman area in Cleveland County's 8n-1w and 8n-2w. Some good drilling prospects were found in this area in the past 6 years by Superior and others majors. Other geophysical work was done in nearby McClain, Grady, and Garvin counties in the past few months.

Madill . . . The Madill area in Marshall County has been heavily prospected in recent weeks by Superior. The focal point in this area is in 5s-5e and 5s-6e. For the past few years extensive work has been done in this district by Shell, Atlantic, Stanolind, Carter, Gulf, and others.

Kay . . . Another actively prospected Oklahoma County is Kay in the northern part of the state. Superior has made surveys in 27n-2w and 28n-2w in another competitive area. Controls were established in 11-27n-2w.

Blaine . . . Seismic work is under way in this previously inactive region by Sohio. That company's crews are busy near the corners of Blaine, Major, and Kingfisher counties . . . 19n-10w and 19n-11w, lapping over into 20n-11w.

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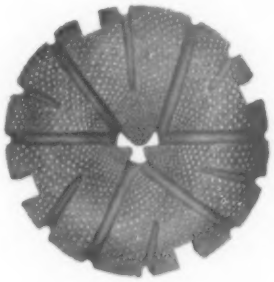

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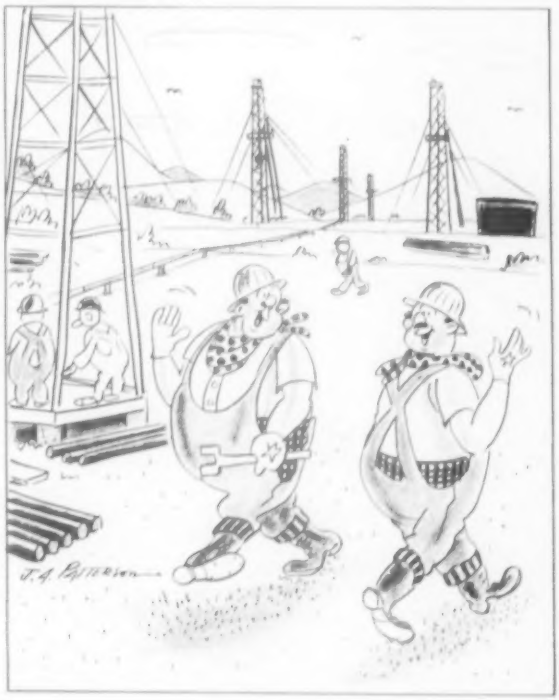

"Hi, Handsome."
"Hi, Handsome."

A small amount of prospecting is reported in Canadian County.

Bryan . . . The east portion of this county has had seismic work in the past several months. Phillips worked 6s and 7s-7e and 8e, particularly in 19-7s-8e.

NORTH TEXAS

Grayson County Prospect

Russell Maguire 1 Chiles, located 1½ miles southwest of Pottsboro in northern Grayson County, developed 1,290 ft. of oil on drill-stem test at 8,147-79 ft. The section tested was not identified.

Location in Section 26, University League Block 1, Washington Survey, A-1522, is 2 miles northwest of South Pottsboro field.

Dallas County . . . Magnolia Petroleum Co. 1 Trigg estate, Ellenburger wildcat 7 miles west of Dallas, was drilling below 7,394 ft. in hard sand. No tests have been reported.

Fisher County . . . New production from the lower Strawn limestone was opened in southwestern Fisher County at General Crude Oil Co. 4 Edwin Aiken, in Section 249, Block 3, H&TC Survey.

Production through ¼-in. choke was 97.3 bbl. of 41° oil in 24 hours, plus 17 bbl. of water. Perforations were from 6,793-6,809 ft. Gas-oil ratio was 723:1 and flowing tubing pressure was 190 psi.

Sweetwater field development . . . This new Canyon sand field, 4 miles north of Sweetwater, gained its fourth producer, and a west extension, at Sinclair Oil & Gas Co. 2 McIntyre. Daily flowing potential was 1,081 bbl. of 41.5° oil through ½-in. choke. Pay section was perforated at intervals between 5,196-5,258 ft.

On the north side of Sweetwater field, Southern Production 1 Rossen tested oil and gas-cut mud on two drill-stem tests. These were run at 5,300-30 ft. and 5,250-5,300 ft. The latter section developed 2,900 ft. of free oil

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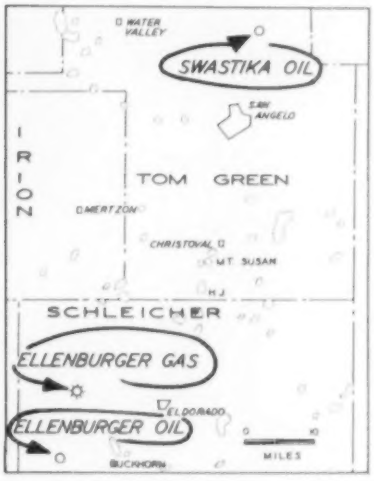
WEST TEXAS-NEW MEXICO

WEST TEXAS

Tom Green, Schleicher Have Discovery Prospects

Tom Green and Schleicher counties last week had prospects of two oil strikes and a new gasser.

Union Oil Co. and Ray Smith Drilling Co. 1 Marschall, north of San Angelo in northern Tom Green County,



gave the county its only production from the Swastika section. (Swastika is a sand member of the Cisco stage). Nearest Cisco production is in Wendkirk field, 15 miles to the north of 1 Marschall, in Coke County.

Initial test of the Swastika, on straddle-packer test between 3,848-62 ft., had gas in 4 minutes and oil in 20 minutes which flowed for 15 minutes at the rate of 65 bbl. an hour. Gravity was 41.5°, there was no formation water and flowing pressure ranged

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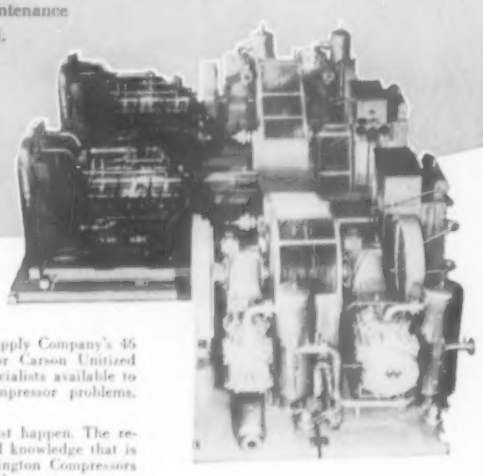

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from 400-1,095 psi. Choke sizes were not reported.

Tentative top on the Swastika was 3,846 ft. on elevation of 2,093 ft. The well was originally scheduled as a 6,500-ft. Ellenburger test, but plans now are to complete the well after running electrical surveys.

Drilling deal on 1 Marschall was worked up by Jones & Lyons, San Angelo, and turned to Union Oil to drill. Field sources indicated further tests would indicate a Cambrian test.

Mount Susan development . . . This new Strawn field gained its third well and a southwest extension at Paul C. Teas 1-B Brown. Calculated daily potential was 176 bbl. of 40° oil through 14/64-in. choke from pay at 5,238-43 ft. Gas-oil ratio was 462:1.

Schleicher County discoveries . . . Delta Gulf Drilling Co. 1 Sol Mayer, 18 miles southwest of Eldorado, flowed at the rate of 25 bbl. an hour while testing the Ellenburger. Acid treatment through perforations at 8,188-8,226 ft. resulted in this flow, under tubing pressure of 150 psi. Tubing choke was 1-in. Location is in Section 3, Block 5, GC&SF Survey.

New gasser . . . Continental Oil Co. 1 Moore estate, 12 miles west of Eldorado, was scheduled for completion after flowing gas from the Ellenburger at 7,730-64 ft. Calculated daily open-flow potential was 985,000 cu. ft. of gas. Top of the Ellenburger was 7,710 ft.

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ARK-LA-TEX

ARKANSAS

New Pays and Extensions Featured April Activity

Pleasant Grove . . . E. D. Markham 1 Decimus Cates, C SW SE SW 33-18s-14w, Union County, pumped 15 bbl. of oil per day from Nacatoch at 2,130-40 ft. to open Pleasant Grove field. Further development in this area north of the Pleasant Grove school is expected.

Irma . . . Jones-O'Brien, Inc., opened Cotton Valley oil production just north of shallow pays on the Irma fault at 3 Tommy Jackson, 31-13s-20w. This well made 69 bbl. of oil per day from 3,680-84 ft. in the top part of the Cotton Valley.

Willisville . . . H. T. Pannell 1 Eva Rogers, NW SW SW 17-14s-21w, ¼ mile west of Nacatoch production in Willisville field, pumped 22 bbl. of oil per day from Buckrange at 1,962-68 ft. to open first production in the area from that zone.

In C NW SW SW 17-14s-21w, X-1 Eva Rogers, completed in the Tokio at 2,148-54 ft. for another new pay.

West Woodley extended . . . E. D. Markham 1 W. B. Newton estate, C SE NE SE 35-17s-15w, West Woodley field in Union County, pumped 15 bbl. of oil per day to extend Nacatoch production here ¾ mile north.

NORTH LOUISIANA

Two New Pays and One Extension Finaled in April

North Louisiana reported no new field discoveries in April, but recorded two new-pay strikes and one extension.

Claiborne . . . T.L. James & Co., Inc., 1 Scaife, NW NW 28-22n-5w, is a new pay-discovery in Antioch field. The well completed flowing 251 bbl. of 48.4°-gravity oil per day on 12/64-in. choke from perforations at 10,298-10,314 and 10,336-44 ft. Gas-oil ratio was 2500:1. Production is from Haynesville. Antioch pay is Smackover.

Lisbon field . . . Hassie Hunt Trust and Associates 1 Thompson et al Unit is a Haynesville "A" zone discovery well in Lisbon field. The well flowed 51 bbl.

of 59°-gravity condensate per day plus 228 M.c.f. of gas on 18/64-in. choke from perforations at 10,147-53 ft. This field had previously produced from the Sligo, Travis Peak, Cotton Valley, and Smackover pays.

Lamar extension . . . Production in this Franklin Parish field was extended 1¼ miles west at 1 O'Brien by Hudson Oil & Gas Corp. in 4-15n-9e. The well flowed 154 bbl. of 41.4°-gravity oil per day on 8/64-in. choke from perforations in the Massive sand of the Tuscaloosa at 5,067-70 ft.

EAST TEXAS

Gas Strike in Gregg County

Gas-distillate production has been opened 1½ miles west of Easton in southeastern Gregg County by Carter-Jones Drilling Co. 1 Stinchcomb.

Initial potential from the "A" zone of the Pettit limestone, perforated at intervals between 7,000-37 ft., was 4,500 M.c.f. of gas, plus 35 bbl. of distillate per 1,000 M.c.f. Choke size was not reported. Flowing pressure was 2,802 psi.

Location of the discovery in Isaac Lee Survey is slightly over 1 mile southeast of Robbins & Jackson's Pettit discovery, which found gas-distillate production in the Pettit at 7,143 ft.

HUGOTON EMBAYMENT

TEXAS PANHANDLE

Hansford County Race Dominates Panhandle

The big Pennsylvanian push in the Texas Panhandle continues to center in Hansford County. Extensions and confirmations plus new wildcat locations were reported in several county areas last week.

Coats Drilling Co. 1 S. P. Miller estate, Section 5, Block 2, PSL Survey, reported its final gage as a Morrow and Cherokee discovery well. The gas discovery is 4 miles northwest of North Hansford-Tonkawa gas field.

Sharples Oil Co. 1 Beck, Section 8, Block 2, SA&MG Survey, 1 mile west of a Tonkawa discovery at North Hansford field, is shut in for potential. The confiramtion well flowed 9,600 M.c.f. of gas per day from Tonkawa at 5,252-95 ft. Flow was on 1-in. choke.

At the northeast confirmation to North Hansford, Sharples 1 O'Donnell Gas Unit, flowed 3,071 M.c.f. of gas per day and distillate from the Morrow. This well is in Section 81, Block 45, H&TC Survey, 8 miles northeast of Gruver. The well confirms production at 1 Ralston, 1 mile southwest.

What extra good will Leschen Lang lay wire rope do for you?

Look at a length of Lang lay wire rope. Compare it with regular lay. Notice that the *wires* in Lang lay rope twist in the *same* direction as the *strands*. In regular lay rope these directions are opposite.

What does that do? It makes the exposed length of the outer wires in Lang lay rope about twice as long as in regular lay rope. It has extra bearing surface to withstand wear from scuffing, rubbing and other abrasive action. Also, because Lang lay wires and strands are laid in the same direction, the rope has greater flexibility.

What's the result? Simply this—on some types of duty, where abrasive and bending stresses are abnormal, Leschen Lang lay rope definitely lasts longer than regular lay. Replacements are fewer. Costs are lower. And, with Leschen you are assured of *higher-than-rated quality* for *longer-than-expected wire rope service.*

Can you use these benefits? To make sure, ask your Leschen man. Leschen makes all types of Red Strand wire rope for all types of jobs, and can help select the best one for you. Perhaps you *should* use Lang lay. Talk to him soon.

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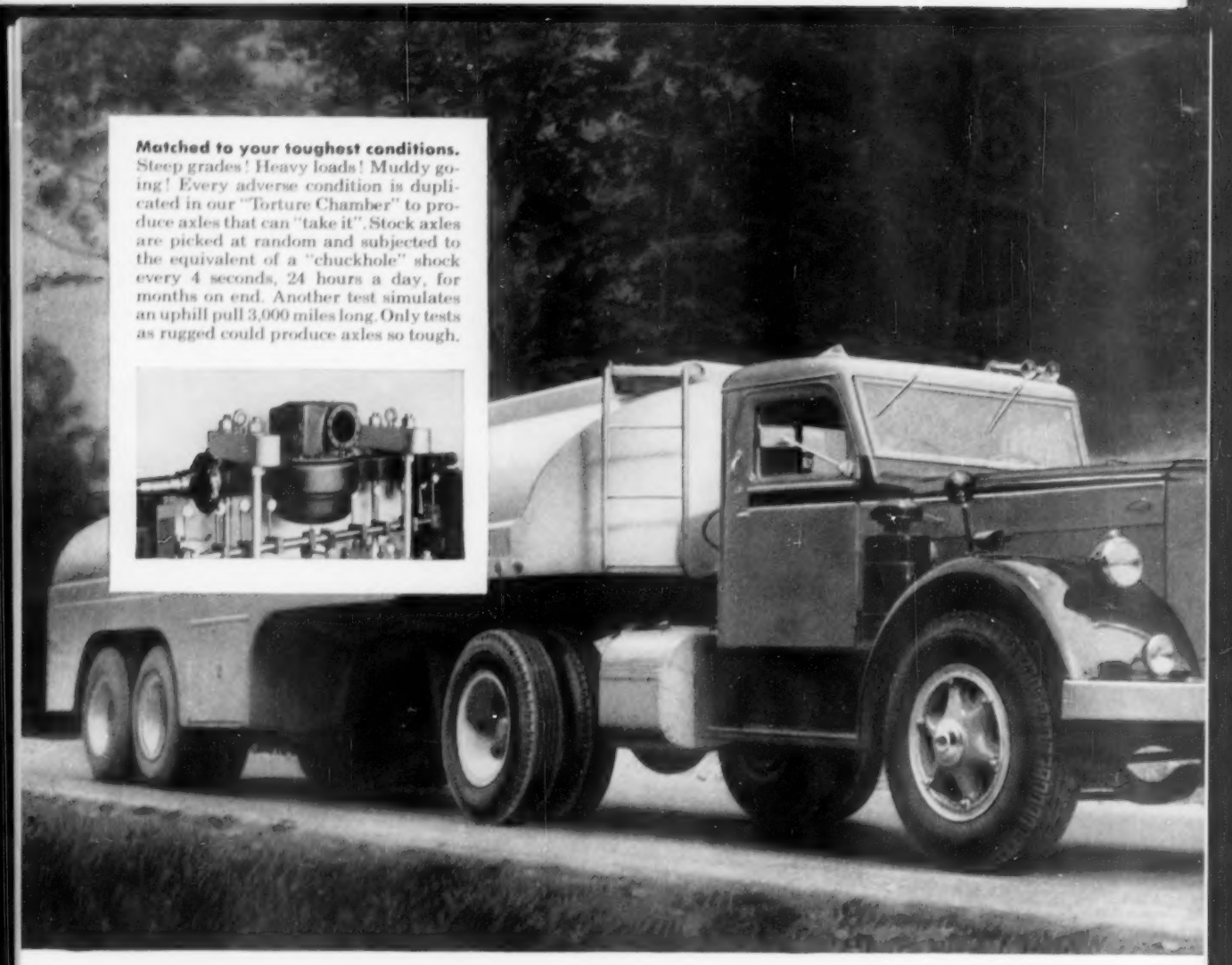


Matched to your toughest conditions. Steep grades! Heavy loads! Muddy going! Every adverse condition is duplicated in our "Torture Chamber" to produce axles that can "take it". Stock axles are picked at random and subjected to the equivalent of a "chuckhole" shock every 4 seconds, 24 hours a day, for months on end. Another test simulates an uphill pull 3,000 miles long. Only tests as rugged could produce axles so tough.

GREATEST ADVANCE SINCE

exclusive double-reduction design 2-speed gear ratio spread!

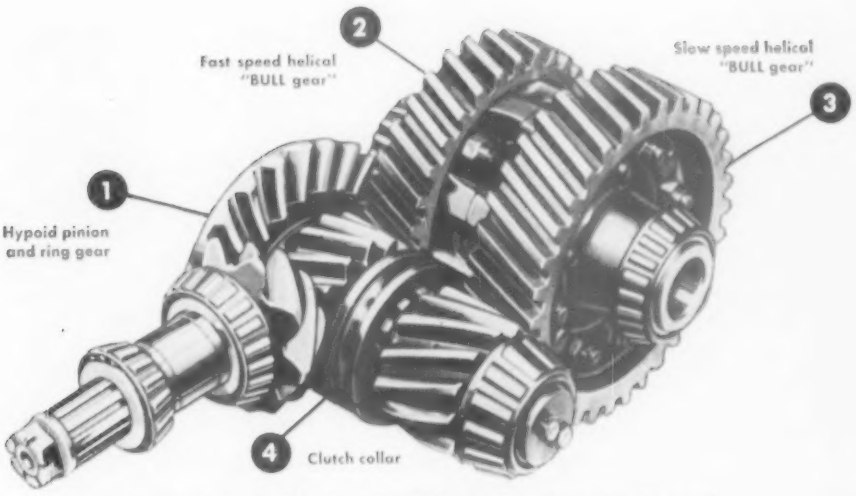
Tailor-made power exactly to your trucking needs with Timken-Detroit!

Unequalled flexibility! TDA 2-Speed Axles, give an almost *unlimited* choice of gear ratios. The Timken-Detroit design is so simple and basic, that an ordinary mechanical change lets you tailor power exactly to your trucking needs. Where other 2-speed axles limit you to only a single gear spread of 37%, TDA offers a range all the way from 28% to 49%.

TDA meets varied needs! The variety of hauling conditions that today's trucks must meet call for maximum speed and power flexibility. Other 2-speed axles are just too limited to meet this need. On the other hand, TDA's simple double reduction design gives complete flexibility. Gear ratio can be easily changed without weakening the axle unit in any way.

How you benefit! TDA not only gives you a much wider power range, but also, all the advantages of a stronger, sturdier, smoother operating design. Since helical "Bull" gear sets operate independent of one another, there is no overheating even after indefinite running in low speed. Bigger huskier TDA parts last longer, stand up better under tough usage.

Less down-time, longer axle life, fewer repairs, higher fuel economy, lower operating costs and higher profits. These are some of the important reasons why so many leading manufacturers and operators everywhere specify Timken-Detroit 2-Speed Axles.



How the exclusive double-reduction design of

TDA 2-SPEED AXLES

gives you greater speed, endurance, and economy!

This is HOW TDA's 2-Speed principle works! A husky hypoid ring gear and a bigger, stronger pinion set (No. 1 in illustration above) provide the *first step* of the total gear reduction for both fast and slow ratios. Two large, heavy-duty helical gear sets provide the *second step*. Both sets are of balanced size and capacity. One set (No. 2 in illustration) is for fast speed; the other (No. 3) is for slow speed. The clutch collar (No. 4) moves to right or left to engage one helical pinion or the other.

WHY this principle offers far wider spread! Because the TDA design is so simple, the ratio may be changed merely by changing the low speed helical gear pinion. Unlike ordinary designs which are limited to 37%, TDA offers spreads of 28%, 37%, and 49%. In effect, this flexibility gives you your choice of power ratios to exactly match your needs.

Greater endurance, longer truck life with TDA. TDA's simple design eliminates small complicated parts and midget size gears. Large hypoid helical design gives more teeth in contact — quieter operation and far less strain. Bearings are larger, too. Helical "Bull Gears" not in use idle, further reducing wear. All this adds up to longer engine life . . . and more efficient and profitable operation under all conditions.

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Each kit is complete — gives you everything you need in one handy package. Gaskets and shim parts, brake liners, steering knuckles, differential gears — for every size of brake and axle. Order by number from your dealer. Cut labor and adjustment costs. Get trucks back on the road quicker.

GULF COAST

TEXAS GULF COAST

New Flank Area Opened At Old Saratoga Dome

Michel T. Halbouty has uncovered another producing area in exploration around the flanks of the old Saratoga salt dome in Hardin County.

His new discovery well, 1-A Teel estate, a joint operation with George W. Graham, is on the southwest flank of the dome, 1½ miles south of production on the west flank (West Saratoga field), also discovered and actively developed by Halbouty and associates.

Testing Yegua sand, perforated at 5,280-5,315 ft., it flowed at the rate of 156 bbl. of 38°-gravity oil per day through 11/64-in. choke with pressure of 440 psi.

Production in West Saratoga field is from multiple sands in both the Yegua formation and the deeper Cook Mountain section.

Southern Lavaca County Gets New Wilcox Field

Wilcox sand is being proved productive in a wildcat test drilled by Lloyd H. Smith, Inc., in the extreme southern part of Lavaca County.

Arrow points to Lloyd H. Smith's new Wilcox oil-discovery well in southern Lavaca County.

The wildcat, 1 Sie Nolan, is reported flowing at the rate of 60 bbl. of 35°-gravity oil daily, testing through 5/32-in. choke. Pressure is 1,175 psi. Pay is perforated at 7,876-78 ft. Total depth is 8,056 ft.

Location, in the J. P. Smith Survey (Abstract 424), is about 4 miles south of Hope, and near the Victoria County line. It is about 2 miles south of Hope field, nearest production, and about 6 miles north of the large Helen Gohlke field, on the Victoria-DeWitt County line.

Humble Plans Test Near Gulf Offshore Discovery

Humble Oil & Refining Co. is getting ready to start a deep test about 1 mile east of Gulf Oil Corp.'s gas-condensate discovery well in the Gulf of Mexico, 3½ miles off Mustang Island, Nueces County, in the lower coastal area.

Humble's test, in State Tract 772, is projected to 12,500 ft. Gulf's discovery well, in State Tract 889, completed early this year, is productive from an 11,450-ft. sand (perforated 11,452-86 ft.). It has been shut in since completion, and no additional wells have been drilled.

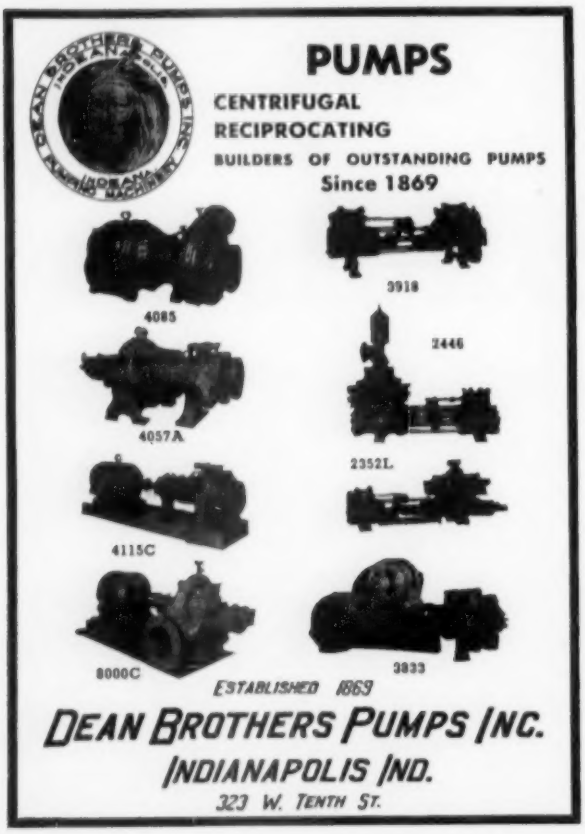
Location is about 9 miles south of Port Aransas in what has been designated as the East Mustang Island area.

SOUTHWEST TEXAS

Active Saspamco Area Gets Two More Good Producers

Continued active development of Austin chalk production in the Saspamco area, on the Bexar-Wilson county line, 15 miles southeast of San Antonio, yielded two more good wells last week.

Branham-McDonald completed their 2 West, in the Jose de la Garza Survey,



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Balanced design means that all parts are equally strong...equally rugged. There are no "weak" parts to fail under load...to attract stresses and strains. Each part carries its full share of the load. The result...economical, long service...less down time!

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making 437 bbl. of 25°-gravity oil per day pumping and flowing by agitation.

The Rodgers, Inc., completed 3 Miller, in the Mariano Seguin Survey, good for 349 bbl. per day on the pump, flowing by agitation.

Both wells are bottomed at 2,900 ft., and are completed in open hole, the former from 2,865 ft. and the other from 2,867 ft.

Chalk production in the area, 3 miles southwest of Saspamco, in Wilson County, and about the same distance southeast of Elmendorf, in Bexar County, was opened 1 year ago this month. It is from fractures, or crevices, and has proved unusually prolific.

Milam County Deep Test Drilling to New Objective

Texas Gulf Sulphur Co.'s much-watched deep wildcat test 3½ miles west of Milano, in southern Milam County, is being deepened below its original projected depth of 10,000 ft. to a new objective of 12,000 ft.

No geological information has been released on the test, but various rumors have been circulated that saturated sand was cored between 9,500 and 9,800 ft. Rumors credited the sand as being of possible Cotton Valley or Smackover age.

Hole has 7-in. casing to approximately 9,870 ft.

The test is on a block of about 8,000 acres controlled by the operator. Location, in the Jose Leal Survey, is on fee-owned land. It is about 5 miles east of the old, shallow Minerva-Rockdale field, nearest production.

Second Producer Confirms New Atascosa Oil Strike

H. H. McFarland and Selby-Walker Corp. have confirmed their recent oil discovery 4½ miles northeast of Leming, in northeastern Atascosa County, near the Wilson County line.

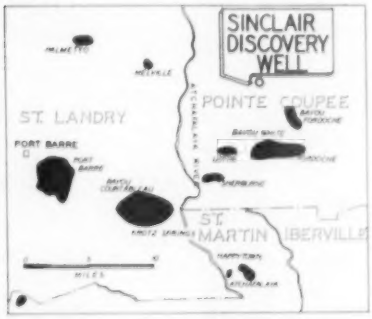
Their second well, 1 Palmer, 1,200 ft. northeast of their discovery well (1 L. B. Palmer), is being completed with a flow rate of 44 bbl. of 33°-gravity oil per day through 5/32-in. choke. Pay, possibly in Navarro sand, is perforated at 2,934-44 ft. The discovery well was a pumper with pay in open hole at 2,885-2,978 ft.

The area is more than 8 miles from nearest production.

SOUTH LOUISIANA

Deep Production Moves to Northwest Anse La Butte

New, deep, flank-sand development around the old Anse La Butte dome, on the St. Martin-Lafayette parish line, is being extended to the far northwest



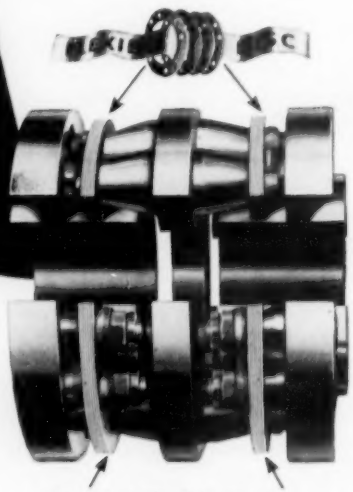
Section around southwest corner of Pointe Coupee Parish, coastal Louisiana, showing location of Sinclair Oil & Gas Co.'s new oil-discovery well.

side, in Lafayette Parish, where Pan American Production Co. has completed a good well at its 1-B Nickerson.

The new discovery well is more than a mile from the old shallow producing area on the dome. It is more than 2 miles around the dome from the multiple-sand producing area being developed on the northeast and east flanks of the dome.

Pan American's new well is rated good for more than 200 bbl. of oil per day, flowing through 11/64-in. choke. Through the latter choke, pressure

Specify THOMAS ALL METAL FLEXIBLE COUPLINGS for Power Transmission to avoid Costly Shut-Downs



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Patented Flexible Disc Rings of special steel transmit the power and provide for parallel and angular misalignment as well as free end float.

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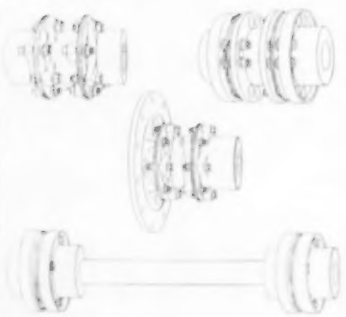

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15% STRONGER—VHS is a new grade of steel for wire rope. It is at least 15% stronger than Improved Plow Steel, which has been the strongest standard grade of wire rope available up to now. This means you can drill to a greater depth before increasing the number of parts of line.

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drives draw works

Smooth as Steam

Ernie Thompson, owner of Scat Drilling Company, reports he's drilling 15% to 20% faster—spending less on maintenance and repairs—since he put an Allison TORQMATIC Converter on his Wichtex rig. Recently, in one 14-day period, he drilled four 1300-foot wells.

But the feature Ernie likes best in his TORQMATIC Converter is its ability to carry a string down the hole without overheating. He says, "Going down the hole, the rig just takes care of itself—all the driller has to watch is the throttle and weight indicator on the draw works—he never has to shift gears. It's taken the human element out of drill rig operation."

This is a rig with a power transmission history. New, it had a torque converter driving through a two-speed mechanical transmission. Then Ernie switched to a straight mechanical drive and a twin Diesel. Now he's settled on his Allison TORQMATIC Converter to drive his Wichtex draw works and says, "It's a honey."

Allison TORQMATIC Converters bring *smooth as steam* operation to drilling, servicing and fracturing rigs because they absorb shock loads instead of transmitting them to other rig components. They automatically match engine power to load demands to speed drilling, increase engine power range, give you faster round trips.

You can get an Allison TORQMATIC Converter in new equipment or in your present rig. Check your dealer, equipment manufacturer or write to Allison Division of General Motors, Box 894R, Indianapolis 6, Indiana for more information.

GM TORQMATIC Allison

TORQMATIC DRIVES

gaged 450 psi. with gas-oil ratio of 465 cu. ft. per barrel. Gravity of the oil is 31.2°.

Production is from an 11,500-ft. sand with perforations at 11,506-14 ft. Total depth is 13,705 ft.

New Oil Strike Spreads Pointe Coupee Production

Sinclair Oil & Gas Co. has uncovered a new oil-productive area in southern Pointe Coupee Parish, on the inland fringe of Louisiana's coastal fields.

The discovery, 6 miles northwest of Fordoche, is the more northern field in the parish so far. Nearest field is at Bayou White, 3½ miles south. Fordoche field, the parish's largest producing area, is 5½ miles south. It is 30 miles northwest of Baton Rouge.

Discovery well is 1 Gosserand, in 11-5s-8e. In Wilcox sand, perforated at 10,396-10,418 ft., it flowed at the rate of 270 bbl. of 44.4°-gravity oil per day while testing through 3/16-in. choke. Flow was under pressure of 1,275 psi. on the tubing side with 1,350 psi. on the casing. Gas-oil ratio measured 2,259 cu. ft. per barrel.

Hole was drilled to 10,513 ft.

Magnolia Petroleum Co. has given up its deep wildcat test at 1 Nicholson, in 92-6s-9e, 6 miles southeast of Fordoche, following a series of unsuccessful tests of sands at 10,675 ft. and 11,525 ft. It was drilled to 11,779 ft.

GREAT LAKES

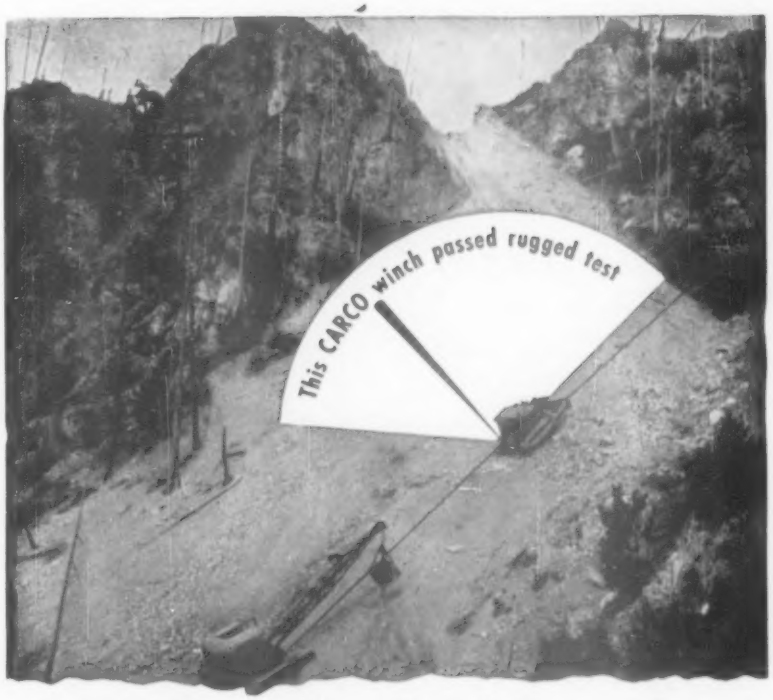
MICHIGAN

New Pay Zone Tapped At Northville Pool

A new, shallower oil pay was tapped in Northville pool, Wayne County, which may lead to a new round of exploration and development.

The new pay is now being prepared for test and completion. It is the Niagara between 3,046-3,190 ft. Previously, only oil pays tapped in Northville wells were in the Trenton-Black River section at about 4,200 ft. The Dundee, Niagara, and Trenton sections have all carried gas pays in this pool.

This first Niagara oil well in the pool is Taggart Co. 1 Crowe-Fraser et al, NE SW SE 7-1s-8e. The well flowed a total of 174 bbl. of oil in 4¼ hours on drill-stem test. The bulk of the acreage immediately surrounding this new oil well is owned by Pure Oil Co. and the Taggart Co. The well is located 1 mile diagonally southeast of the Taggart 1 LeMaster Trenton oil discovery. This may be the first Niagara oil producer drilled in Michi-



CARCO winches held fast when slippage meant disaster

... on tough Alberta to Vancouver pipeline job

Towing and holding heavy equipment on steep grades is a severe test of a winch brake. On the Model J Carco winch, the automatic, self-energizing brake will hold any load the winch can pull. It takes hold the instant tractor clutch is disengaged. Full braking power comes from high ratio leverage contracting the band on brake drum. Brake unit is reversible, permitting under- or over-wind free-wheeling. Brake release mechanism gives the operator complete load control at all times. The load can be checked at any point and even be "inched" down. Brake is enclosed, protecting it from the elements or external abuse.

Mr. G. T. Guest, Assistant to Project Manager of Comstock Midwestern, Limited, builders of "Big Inch-by-Inch", says, "The job needed Carco winches for towing and holding heavy machinery on steep grades and even for holding men by life lines. Had a single winch failed, men and machinery would have been lost. We found Carco winches equal to everything we asked of them."

On top of hill a Model J Carco winch is winching the Carco J winch and International TD24 shown above up steep slope at Coquihalla Canyon while it, in turn, is winching up clam digger.

You can expect greater value from the leading producer, and get it from Carco, first in winch production. PACIFIC CAR AND FOUNDRY COMPANY, Renton, Wash. Branches at Portland, Ore., and Franklin Park, Ill.

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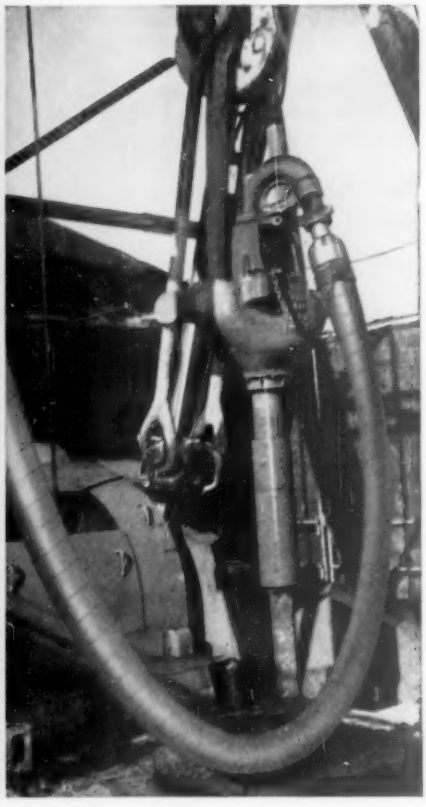
. . . and get "More Use per Dollar"

Select a hose construction with an engineered strength member reinforcement properly positioned for maximum safety, flexibility and long life.

Rotary hose with the strength member properly engineered in design and position has high flexibility without bulk . . . is easier to rig-up without accident . . . holds steadier in the derrick and resists whipping under high pressures of deep drilling. Solid wire strength member reinforcement, as used in some hose, is stiffer and more vulnerable to kinking at bending points. Such hose is weakened by extra bulk, insufficient safety factor and abuses which can lead to eventual hose failure. Hose that is flexible, yet strong, is safer on the job because it is easier to handle . . . less likely to be abused or damaged when transported from location to location.

The hose coupling is also vital to hose safety and long life. Make certain the coupling on your hose is designed without protruding lugs or flanges . . . engineered to prevent costly leaks and dangerous blowouts.

Specify by name the one rotary hose specially developed to insure longer, safer use . . . specify "Ray-Man" CBL Rotary Hose.



RAY-MAN CBL ROTARY HOSE

The Manhattan method of applying high tensile steel cable under precisioned tension makes Ray-Man CBL Rotary Hose unequalled for strength, flexibility and safety. It has unusual resistance to kinking or accidental crushing. This special reinforcement also makes it easier to make up on the rig. Ray-Man CBL Rotary Hose features Manhattan's streamlined, built-in coupling with the leak-proof "Lip-Lok" Seal that tightens under pressure for even greater safety. These features, plus Manhattan's oil-proof tube, add up to easy handling and trouble-free service at less cost. Write for Bulletin #6743 which tells you how you can drill more hole per hose . . . get "More Use per Dollar" with Ray-Man CBL Rotary Hose.

RM 509

R/M

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gan. There are two other wells which are called Niagara oil producers, but these may be from the basal Salina-Niagara contact. One of these is a lone producer in Mason County, and the other is a lone, and small producer in Otsego County.

APPALACHIAN

PENNSYLVANIA

Parker Township, Butler County, Southwest Pennsylvania, Walker et al 1 John Walker, wildcat shut down at a depth of 7,620 ft., to Hydrofrac.

- Buffington Township, Indiana County, Felmont Oil Corp. 1 Marjorie Shankel is drilling at 7,850 ft.
- Unity Township, Westmoreland County, Peoples Natural Gas Co. 2-4037 Fred Musnug has reached a depth of 4,410 ft.

WEST VIRGINIA

Sherman district, Hampshire County, West Virginia, M. E. Anderson 1 J. E. & B. Orndorff, rank wildcat, elevation 1,281 ft., is drilling at 2,352 ft.

- Licking district, Tucker County, Hope Natural Gas Co. 9924 Alex Nestor Hrs., elevation 1,764 ft., shut down at 5,123 ft. to Hydrofrac. The 9940 James E. Watson is drilling at 420 ft.
- Dry Fork district, Randolph County, Columbian Carbon Co. 1207 Lawrence Burger is still drilling in the Oriskany sand and is at a depth of 5,038 ft. Another gas pocket was encountered at 5,034-36 ft.

EASTERN KENTUCKY

In Leslie County United Fuel Gas Company have abandoned their wildcat 14 Fordson Coal Co. Significant markers include: Maxon sand 1,277 ft., Big lime 1,445 ft., Corniferous 2,179 ft., and Clinton shale 2,300 ft. to 2,304 ft. total depth. Several showings of gas proved to be noncommercial.

TENNESSEE

Oil and Gas Development In Tennessee in 1954

Drilling activity for 1954 was less than had been expected, according to H. C. Milhous, Senior Geologist, Tennessee Division of Geology. Only 17 wildcats were completed. While interest in western Tennessee was still high, only one test was drilled in that area. No commercial oil was discovered, but one small gas well was brought in.

Development . . . Two tests drilled during the year were more than 3,000 ft. in depth, or approximately three times the average depth for holes drilled in Tennessee. One of these, Greenup-Davis et al 1 Coal Creek Mining & Manufacturing Co. in Anderson County, became a small commercial gas well, but its potential is not yet known. The well was drilled just west of the edge of the escarpment dividing eastern and middle Tennessee. It is the first to be drilled along the escarpment and the first in Tennessee to obtain a sizable amount of gas at or in the base of the Chattanooga shale. Other tests are planned for the area.

The other deep test was drilled in Hardin County in western Tennessee. It was bottomed at 3,427 ft. after penetrating more than 2,000 ft. of Knox dolomite (Cambro-Ordovician). Two tests were started in Claborne County in eastern Tennessee but were temporarily shut down at the close of the year.

Oil production . . . Oil production was 12,800 bbl. in 1954. Production by counties was as follows: Morgan-Scott, 7,073 bbl.; Fentress, 3,392 bbl.; Pickett, 1,555 bbl.; Robertson, 780 bbl.

Gas production . . . Morgan and Scott production was about 83 M.c.f. of gas for the year. Jamestown field produced an estimated 9 M.c.f. and estimate of

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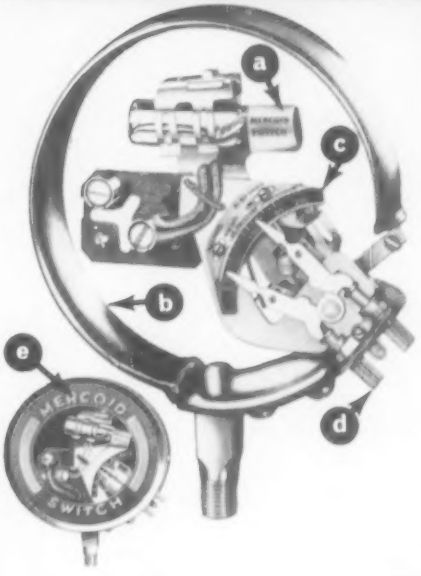

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1 M.c.f. for the Briceville well brings Tennessee's total 1954 production to 93 M.c.f.

EASTERN INTERIOR

ILLINOIS

In Clay County George Cullum and D. P. Lawhead 1 M. Jorgenson, SE SE SE 13-4n-8e, 7 miles northeast of Clay City, recovered 1,440 ft. of oil on a test of the McClosky lime at 3,023-38 ft. The well, a Salem lime test to 3,693 ft., is 1 mile southeast of Passport pool.

• Just north of Eldorado in Saline County the prolific new area has another 1,000-bbl. well. It is Inland 2 Don Vinyard Unit, NE NE NW 21-8s-7e. After fracturing the well flowed 1,000 bbl. per day from the Waltersburg sand at 2,152-80 ft.

PACIFIC COAST

CALIFORNIA

New Beehive Bend Tests

Despite recent setbacks General Petroleum Corp. and Sunray Oil Corp. were preparing new tests in the Beehive Bend gas area of Glenn County. The former will drill 9 Cecil in 21-19n-2w, more than 1 mile southwest of production. Sunray's test, expected to drill to about 11,000 ft., is in SE Section 19. Both operators last month suspended or abandoned tests which failed to find any of the field's four major sands.

Tejon Pool Gets Two Outposts

The new Jewett sand (lower Miocene) pool on the northern edge of Tejon Ranch field, Kern County, received two ½-mile north extension tests. Located down-dip from three 7,000-ft. producers along a 1-mile northeast-southwest trend, their outcome will shed much light on whether the discovery will develop into major importance.

The new tests are Intex Oil Co. 88 Blodgett & Crome in SE SE 28-11n-19w, and Humble Oil & Refining Co. 1 A. B. Newlon. The latter will be ¼ mile west of this test. Both are scheduled to test the Jewett sand, but will have the Olcese and Transition pays as shallower prospects.

Their location was touched off by completion of Reserve Oil & Gas Co. 12-34 Reserve-Pauley in 77 ft. of sand at 7,200 ft. for 724 bbl. of 35.6°-gravity crude. Pinched back with a 14/64-in. choke it produced 490 bbl. daily, along with some 300 M.c.f. of gas. Since the well is almost 1 mile northeast of the "33" location discovery in Section 33, the operator regarded its successful completion as the area's most important extension of the past year.

New Shafter Test Staked

Tide Water Associated Oil Co. was preparing to start a confirmation test to its gas discovery in the Shafter area of Kern County. Its 57-18 Clark in SW SE 18-28s-25e, is ½ mile south of 63-18 Loepp. The latter last December tested 2,344 M.c.f. daily through a 14-in. choke at 4,295-4,305 ft.

Second Island Test Dry

Richfield Oil Corp. abandoned its second wildcat on Santa Cruz Island, 22 miles offshore from Santa Barbara, after drilling to 3,660 ft. The operator carried 1 Santa Cruz Island, located 6 miles northwest in 28-1s-29w, to a total depth of 8,371 ft.

Shell Records Ventura Find

Shell Oil Co. completed its wildcat 4 miles southwest of Santa Paula and

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almost 2 miles southwest of the West Mountain field as a flowing producer. Producing through perforations at intervals between 7,425-7,640 ft., 2 S.P.S. flowed 212 bbl. of 31.5°-gravity crude through a 12/64-in. choke. Three additional upper zones were put behind pipe. Location of the new discovery is in NE SW 29-3n-21w.

Piru Test Below 16,000 Ft.

General Petroleum Corp. reached a depth of 16,075 ft. at its wildcat on the edge of Piru in Santa Clara Valley. It was the deepest of any active well in the state. As 1 Edwards, in 19-4n-18w, was originally scheduled to about 15,000 ft. the wildcat was not expected to go much deeper.

WESTERN CANADA

ALBERTA

Gas Discovery Reported In Wintering Hills Area

Hudson's Bay Oil & Gas Co., Ltd., has rated an initial potential of 4,290 M.c.f. of gas per day at its Wintering Hills wildcat in the southern part of the province, 15 miles north of Bassano and 65 miles east of Calgary.

The discovery well, Hudson's Bay-Stanolind 1 Wintering Hills, LSD 6, 8-24-18w4, earlier this year indicated discovery by drill-stem test in the Ostracod zone of the Blairmore.

Forest Lawn . . . Socony-Vacuum Oil Co. of Canada, Ltd., found a showing of gas in the Crossfield member of the Devonian at its wildcat a few miles east of the Calgary city limits. The well is Socony 36-10 Calgary, LSD 10, 36-24-29w4, tested the Crossfield (D1 Devonian at 8,615-40 ft.

Westward Ho . . . One of the five follow-up drillers to the Westward Ho oil discovery in southwestern Alberta has entered the Mississippian, has cored 18 ft. into that zone, and was being prepared for a drill-stem test.

The other four wells are at depths ranging from 6,600 to 8,700 ft., also nearing their Mississippian objective. Westward-Ho field is about 55 miles north of Calgary and 20 miles west of Olds. The Hudson's Bay-Oilwell Operators 15-5 Westward Ho entered the Mississippian at 8,762 ft. or about 20 ft. higher than the discovery well. The 15-5 well is located about ½ mile south of the oil discovery. Location is on LSD 15, 5-33-4w5.

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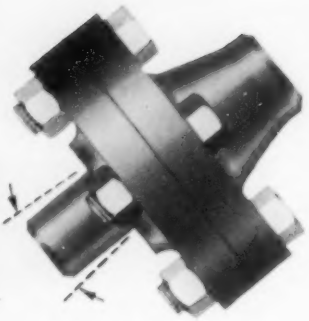

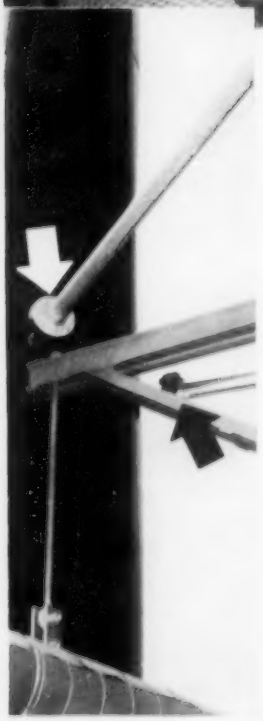

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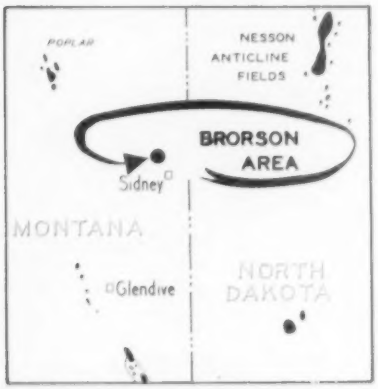
ROCKY MOUNTAIN

MONTANA

Brorson Deep Pay Confirmation Successful

Sun Oil Co. and Phillips Petroleum Co. have recovered apparently commercial quantities of oil on drill-stem test of Red River at a confirmation well in Brorson field, Richland County. The well is 1 Dynneson, SW SE 30-24n-58e. Test of the interval 12,622-83 ft.

Recovery in 2½ hours was 2,880 ft. of oil, 3,500 ft. of 25 per cent oil-cut water cushion, 1,350 ft. of heavily



Sun Oil Co. and Phillips Petroleum Co. recovered 2,880 ft. of free oil on drill-stem test of the Red River-Ordovician at their 1 Dynneson confirming Ordovician production found at the discovery well in 1953. The well is in SW SE 30-24n-58e. The Brorson discovery well was in C SW NE 32-24n-58e. The second well in the field, completed last year, pumped oil from the Madison-Mississippian.

oil and gas-cut mud and 720 ft. of salt water. Flowing pressure was 3,025 psi. at the end of the test. The operators have set pipe and were waiting on cement at last report.

The well is 1 mile southeast of the Red River (Ordovician) discovery well in this field, and is the third well drilled in the field. The second, intended as a confirmation of the Ordovician discovery was completed in Madison without test of the deeper formation. Both the Madison and Ordovician discoveries at Brorson have been in production for some time.

Northwest Sumatra New Pay Discovery Completed

McAlester Fuel Co. has completed NP 5, NE SE 7-11n-32e, in Northwest Sumatra field, Rosebud County for a flow of 192 bbl. of oil per day through 12/64-in. choke. The well is the first in the field to be completed from the Amsden "A" sand. It is not

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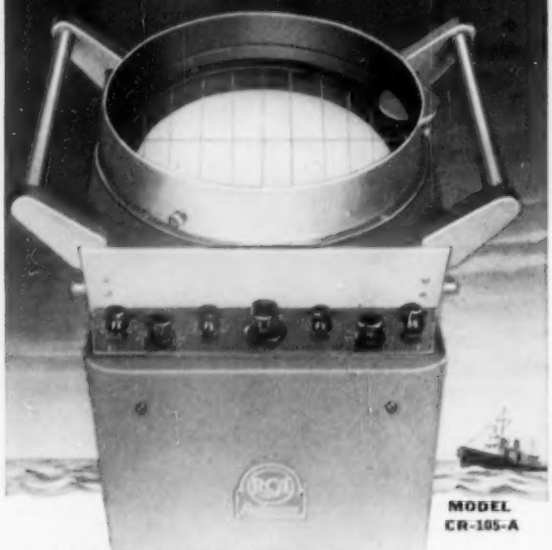

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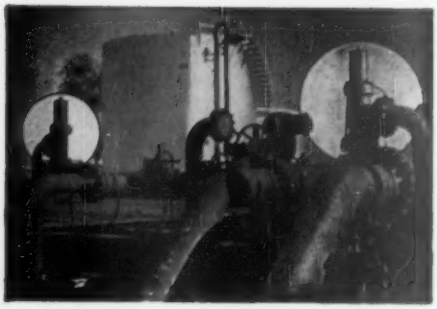

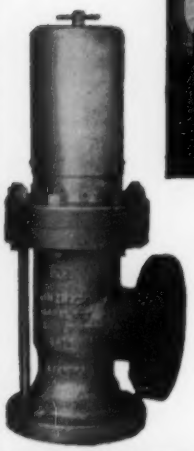

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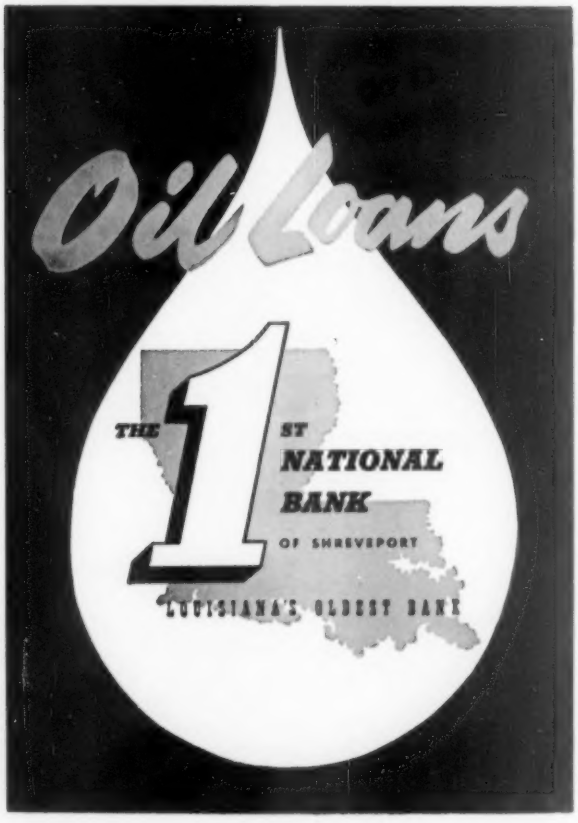

the first to recover apparently commercial quantities of oil from that formation, but the previous well which showed productive capacity in "A" sand was completed in a lower zone of Amsden. The completion of this well establishes the fourth producing horizon in the field.

Stillwater County Wildcat Abandoned

Sohio Petroleum Co. has abandoned Kimball 1, C NE SE 7-3n-19e in the Six Shooter area of Stillwater County. Total depth was 5,275 ft. with the well in Mission Canyon at that depth. It is the second failure in the general area for this operator. Only very slight shows were reported.

NORTH DAKOTA

New Wildcats Located in Bottineau, Rollette Counties

Calvert Drilling Co. has made location for two Lodgepole tests in Bottineau and Rollette counties. The company will drill 1 Stangaland, NE SW 29-162n-86w in Renville County, and 1 Rauk, SE SE 26-163n-79w, in Bottineau County. The area has had recent encouragement through excellent producers completed in Bottineau County fields. There has been no success elsewhere on the eastern side of the U. S. portion of the Williston basin. Drilling is now delayed through much of the general area because of weight restrictions on roads of North Dakota during the spring breakup. Restrictions are expected to be lifted shortly.

Dunn County Deep Test Being Plugged Back to Madison

Mobil Producing Co. is plugging back for test of shows in the Mission Canyon member of Madison at F-22-22I Bird Bear, SE NW 22-149n-91w, Dunn County. Total depth is 13,481 ft. and the operator will perforate 9,000-05 ft. where cores recovered lime with shows of black oil in cores. The zone 8,999-9,036 ft. was tested, with drill-stem recovered of 284 ft. of gas-cut muddy salt water with an oil scum, and 930 ft. of gas-cut salty sulfur water.

SOUTH DAKOTA

Harding County Wildcat Staked

Hunt Oil Co. has moved tools on location at 1 State, NE NW 23-18n-1e, Harding County. The wildcat is to test Red River at about 8,500 ft.

Tips on Mud Valves for Toolpushers . . .

Bill Sauer with a 2" Fig. 2128 MUDWONDER on the mud manifold

Rockwell-Built MUDWONDER Completes 24 Cementing Jobs Without Downtime

By W. E. "Bill" Sauer, Toolpusher
Gabe McCall Drilling Company, Tioga, North Dakota

WITHOUT a doubt the toughest mud valve job on our rig is the standpipe opening we use for bleeding and cementing. There is where we put our first Rockwell-Built MUDWONDER almost a year ago. We have just completed our 24th cementing job through this amazing valve and our books show that the original gate and insert are still in the valve. Previous records for inserts in this service were from 4 to 6 jobs.

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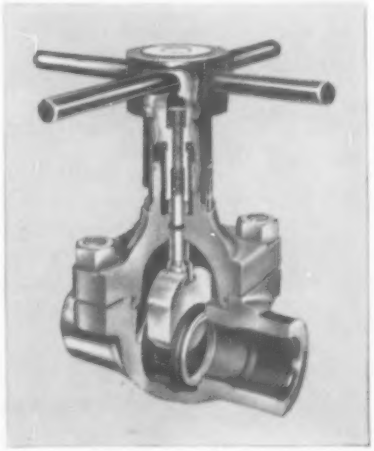

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Previous drilling in the general area by Northern Ordnance Co. several years ago resulted in two failures. The dry holes are 1 mile south of the Hunt Oil location.

NEBRASKA

Kimball County Discovery Near Completion

Tom Palmer, Inc. has run pipe at 1-E State, NW NW NW 16-16n-53w, Kimball County. The operator recovered 2,700 ft. of oil on test of the "J" sand at 5,662-69 ft. Recovery also included 120 ft. of oil-cut mud and 30 ft. of oil-cut water. The apparent discovery is 3 miles southeast of Schmid field.

COLORADO

Mesa County Wildcat Is Small Oil Discovery

Great Basins Petroleum, Inc., has completed 2 Unit, SW SE SE 29-8s-100w, in the Hunter's Canyon unit as a Mesaverde oil discovery. The operator swabbed 20 bbl. of oil per day from the zone 1,140-60 ft. and estimated a pump recovery of 40-45 bbl. daily. The well is 120 ft. south of a gas discovery completed earlier this year with production from a Mesaverde sand. Total depth of the current well is 6,053 ft., in Entrada.

Two Apparent Denver-Julesburg Discoveries Tested

J. W. Braden Oil Co. and James Hoover reported recovery of gas at the estimated rate of 3,000 M.c.f. per day on test of "J" sand at 1 Brachtebach, C SE NW 26-8n-54w, Logan County. Test was of the interval 5,102-10 ft. Tool was open 1 hour and 40 minutes.

In Adams County, Jack Ladmer, Denver independent recovered 133 ft.

A rank Yuma County wildcat in eastern Colorado reported slight shows in a core of the Dakota "D" sand. It is Shell Oil Co. 1 Sheldon, C SW NE 7-4n-42w, more than 40 miles east of Denver-Julesburg production.

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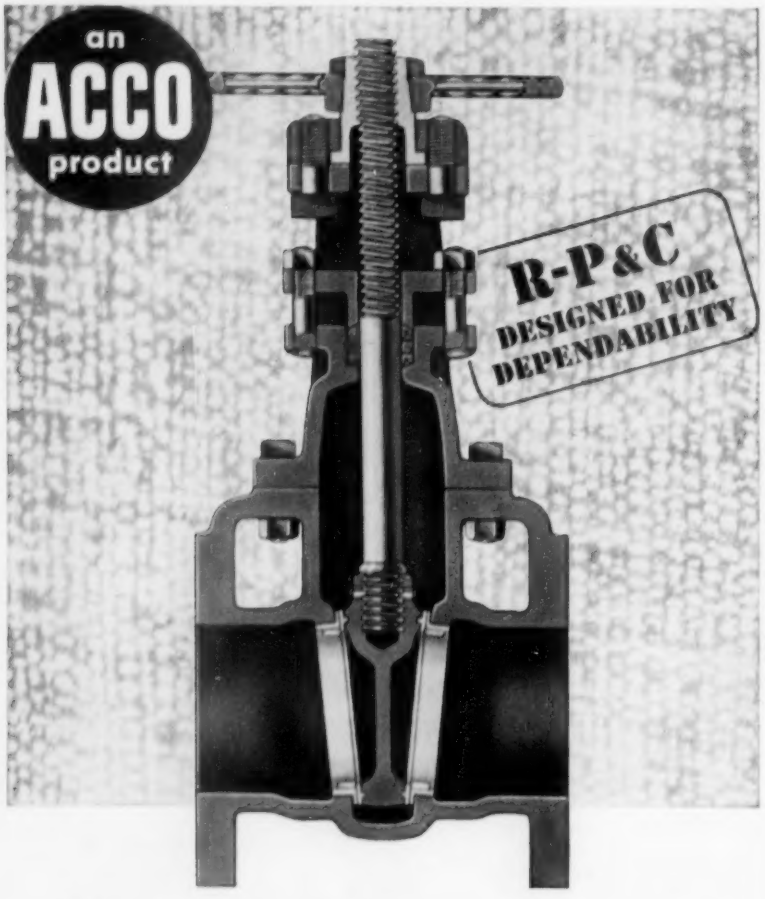

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of black oil, 40 ft. of oil and mud and 328 ft. of water on test of 1 Coordes, C SW SW 7-1s-57w. Another test at 5,780 ft. flowed gas at the rate of 2,000 M.c.f. per day. Both tests were in "D" sand.

WYOMING

Northwest Byron Apparent Discovery Swabbing

Phillips Petroleum swabbed 66 bbl. of low 25°-gravity oil and 9 bbl. of water in 6 hours at 1 State-Lodestone, SW SW NW lot 27-56n-97w, Big Horn County. The zone 6,172-80 ft. was perforated. Top of Tensleep is at 6,165 ft. The operator is continuing tests at the discovery, which is 1½ miles northwest of production at Byron.

Campbell County Wildcat Location Made

Cranlyn Exploration Co. of Wichita has made location for a wildcat in the West Recluse area of Campbell County. The well is 1 Government, C NE NW 33-54n-73w. The operator has not designated the objective formation or depth.

The location is 9 miles north of Aden field where the Texas Co. had a small short-lived Minnelusa discovery several years ago.

Casing Run At Natrona County Wildcat

Houston Oil Co. has run pipe and is last reported waiting on cement at 1 Clark Ranch, C SE NW 6-35n-84w, Natrona County. The wildcat was tested in Tensleep at 4,675-95 ft. with recovery of 870 ft. of black low gravity (15.8°) oil in 2½ hours. Another test at 4,734-59 ft. recovered 970 ft. of oil-cut mud and water in 65 minutes. The apparent discovery is 5 miles northwest of the old Pine Mountain field.

Successful Wildcats

SOUTHWEST TEXAS

Frio County: The Texas Co. 1-B Kothman NCT-2, Joel C. Bradford Sur. 967, A-79. IP 105 BOPD, 5/32-in., 24°, GOR 236 cu. ft. per barrel, Austin chalk 7,336-87 ft. (perforations). TD 8,500 ft. (New pay in Hindes field).

TEXAS GULF COAST

Hardin County: Sinclair Oil & Gas Co. and Houston Oil Co. 6 Rafferty fee, James Rafferty Sur., A-45. IP 70.12 BOPD, 5/32-in., 51.6°, GOR 8,647 cu. ft. per barrel, Yegua 7,330-40 ft. (perforations). TD 7,793 ft. (New pay in North Silsbee field).

Harris County: Industrial Gas Supply Co. 5-B Harris County L. & I Co., Lot 18, Victor Blanco Sur., A-2. IP 20,800 M.c.f. daily, open-flow potential, Yegua 8,398-8,408 ft. (perforations), and 77.91 BOPD, 7/64-in., perforations 8,056-60 ft. TD 9,001 ft. (New pay — 8,400-ft. Yegua sand — in Alco-Mag field.)

Federal Royalty Co. 1 Fuchs, Francis P. Herring Sur., A-369. IP 91½ BOPD, 5/32-in., 36.2°, Cockfield 5,886-92 ft. (perforations). TD 6,256 ft. (New field—Rotherwood.)

Jefferson County: Stanolind Oil & Gas Co. 7-B Gladys City, J. A. Veatch Sur. IP 97,000 M.c.f. daily, open-flow potential, GCR 146.3 M.c.f. per barrel, 50°, perforations 5,572-96 ft. TD 6,302 ft. (New pay in Spindletop field.)

Live Oak County: Atlantic Refining Co. 3 Lyne, Jacob Cook Sur., A-142. IP 70.71 BOPD, ⅛-in., 21.7°, perforations 2,728-34 ft. (Hockley sand). TD 3,480 ft. (New pay in Tom Lyne field.)

Matagorda County: J. M. Huber Corp. 2 Anderson, Elisha Hall Sur. IP 5,200 M.c.f. daily, 8.34 BC per M.M.c.f., 7/32-in., perforations 10,149-52 ft. TD 10,505 ft. (New pay in Lucky field.)

Nueces County: Spartan Drilling Co. 1 Spessard, Canutillo Colony Ditch Co. Sur., A-464. IP 107 BOPD (net), 15.6 per cent water, 7/64-in., 46.6°, perforations 8,129-33 ft. TD 8,795 ft. (New pay in Luby field.)

TEXAS PANHANDLE

Hemphill County: Sun Oil Co. 1 Dale Nix, 42-81, H&TC. IPF 28 BOPD, Cherokee-Penn 9,615-66 and 9,705-40 ft., 24/64-in., 50.8°. TD 12,714 ft. (First production in county).

WEST CENTRAL TEXAS

Jones County: Dugger & Herring 1 Meadows, 32-19-T&P, 10 mi. N Merkel. IP 686 BOPD, 24/64-in., 42°, TP 450 psi., GOR 680, upper Strawn perforated 4,739-47 ft. TD 4,980 ft., elev. 1,847 ft.

Taylor County: Lone Star Producing Co. 1 Voss, P. Casillas Sur. 455, 11 mi. W Bradshaw. IP 25 BOPD, 16/64-in., 32°, GOR 40,421:1, TP 945 psi., Gray sand 5,072-84 ft. TD 5,532 ft.

NORTH TEXAS

Grayson County: A. D. Britton 1 Parish, Asa Hartsfield Sur., A-491, 2 mi. SE Whitesboro. IPP 99.6 BOPD, no water, 24°, Strawn 4,687-4,708 ft. TD 4,776 ft., elev. 768 ft.

Montague County: Transcontinental Oil Corp. 1 Larison, Blk. 17, Calhoun CSL Sur. 12, 4½ mi. SE Montague. IP 264 BOPD, 14/64-in., 43°, TP 150 psi., GOR 440, conglomerate pay 6,819-24 ft. TD 7,001 ft., elev. 1,198 ft.

Young County: E. C. Brown 2 Willis estate, Sec. 2, SPRR Sur., 5 mi. E Graham. IPP 35 BOPD, no water, 41.5°, GOR 400, pay 2,205 ft. TD 2,208 ft.

Kenneth J. Rich and Louis Pitcock 1 Rodgers estate, J. Ray Sur., A-1668, 7 mi. SW Graham. IP 192 BOPD, 24/64-in., TP 180 psi., 42°, GOR 400, Caddo 3,640-57 ft. TD 3,705 ft.

SOUTHEAST NEW MEXICO

Chaves County: Atlantic Refining Co. 1 Federal, 7-11s-31e, 7 mi. W, slightly S Caprock. IP 174 BOPD, TP 20 psi., GOR 724, 41.7°, Wolfcamp pay 7,929 ft. TD 10,763 ft., elev. 4,159 ft.

WEST TEXAS

Garza County: W. J. Mosley 1 Middleton, 8-8-H&GN, 11 mi. NE Post. IPP 5 BOPD, no water, 37°, GOR zero, pay 2,478 ft. TD 3,120 ft.

Scurry County: D. W. Varel 1 Smith, 488-97-H&TC, 4 mi. E Fluvanna. IPP 91 BOPD, 33°, GOR zero, pay 2,735-55 ft. TD 2,880 ft.

INDIANA

Daviess County: L. J. McGinness 1 Swayze, NE SW SW 2-4n-5w. IPP 5 BOPD, Salem 823-26 ft. TD 826 ft. (Opens Raglesville pool).

OKLAHOMA

Atoka County: T. C. Huddle 1 Snyder et al, NW NE SE 35-2s-13e. IPP 1 BOPD, 480-87 ft., 33°. TD 508 ft. (Oil discovery).

KANSAS

Cowley County: Aylward Drilling Co. 1 Brandenberg "A," SW SW NW 3-35s-3e. IPP 20 BOPD, Miss. 3,364-71 ft. TD 3,780 ft. (Opens Brandenberg pool.)

Sumner County: Stelbar 1 O'Hara, NE SE NW 19-32s-1w. IPF 423 BOPD, Kansas City lime 3,256-64 ft., 36°. TD 3,771 ft. (Oil discovery.)

CALIFORNIA

Kern County: Reserve Oil & Gas Co. 12-34 Reserve-Pauley, NW NW 34-11n-19w. IPF 724 BOPD, 18/64-in. choke, 35.6° gravity, perfs. 7,190-7,267 ft. in Jewett (Miocene) sand, TD 11,687 ft., redrilled TD 7,324 ft. (About ½ mile northeast extension to JV pool of Tejon Ranch field.)

Sacramento County: Brazos Oil & Gas Co., Operator 3 Tyler Island Farms, NW NE 5-3n-4e. IPF 2,800 M.c.f. gas, 7/16-in. choke, 1,180 psi. tubing pressure, perfs. 3,618-3,770 ft., TD 4,607 ft. (About 1 mile south extension of Nortonville pool or River Island field.)

ALBERTA

Hudson's Bay 1 Wintering Hills, LSD 6, 8-24-18w4. Ostracod gas well. TD 4,560 ft.

LEGAL

SEALED BIDS will be received until May 19, 2:00 P. M. Central Standard Time, and opened at that time in the Office of the Superintendent, Fort Berthold Indian Agency, New Town, North Dakota, for the leasing of 8,908.60 acres of allotted Indian land, located in township 149 N. R. 94 W., township 150 N. R. 94 W., township 150 N. R. 95 W., McKenzie County, North Dakota for oil and gas mining purposes. The details of the lease offering and how and where to file bids may be obtained by addressing the inquiry to the Superintendent of the Fort Berthold Indian Agency, at New Town, North Dakota, or call the Agency Land Office, Phone 74340, New Town.

LEGAL

SEALED BIDS will be received until 2:00 P. M. Monday, May 23, 1955, and opened at that time at the Pawnee Sub-Agency office for the leasing of allotted lands located in Kay, Noble, Pawnee and Payne Counties, Oklahoma, for oil and gas mining purposes. For additional information write or telephone Mr. Johnson, Area Field Representative of the Pawnee Sub-Agency Office (Phone 985).

LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Santa Fe, New Mexico. Notice is hereby given that approximately 3,603.88 acres of land in sixteen parcels within the known geologic structures of certain fields in Rio Arriba and San Juan Counties, New Mexico, will be offered for oil and gas leasing through competitive bidding to the qualified bidder of the highest cash amount per acre at 2:00 P.M., MST, May 24, 1955, when bids will be opened. Details of the lease offering, how and where to submit bids, may be obtained from the Bureau's Land Office at Santa Fe, New Mexico. J. A. DeLany, Manager.

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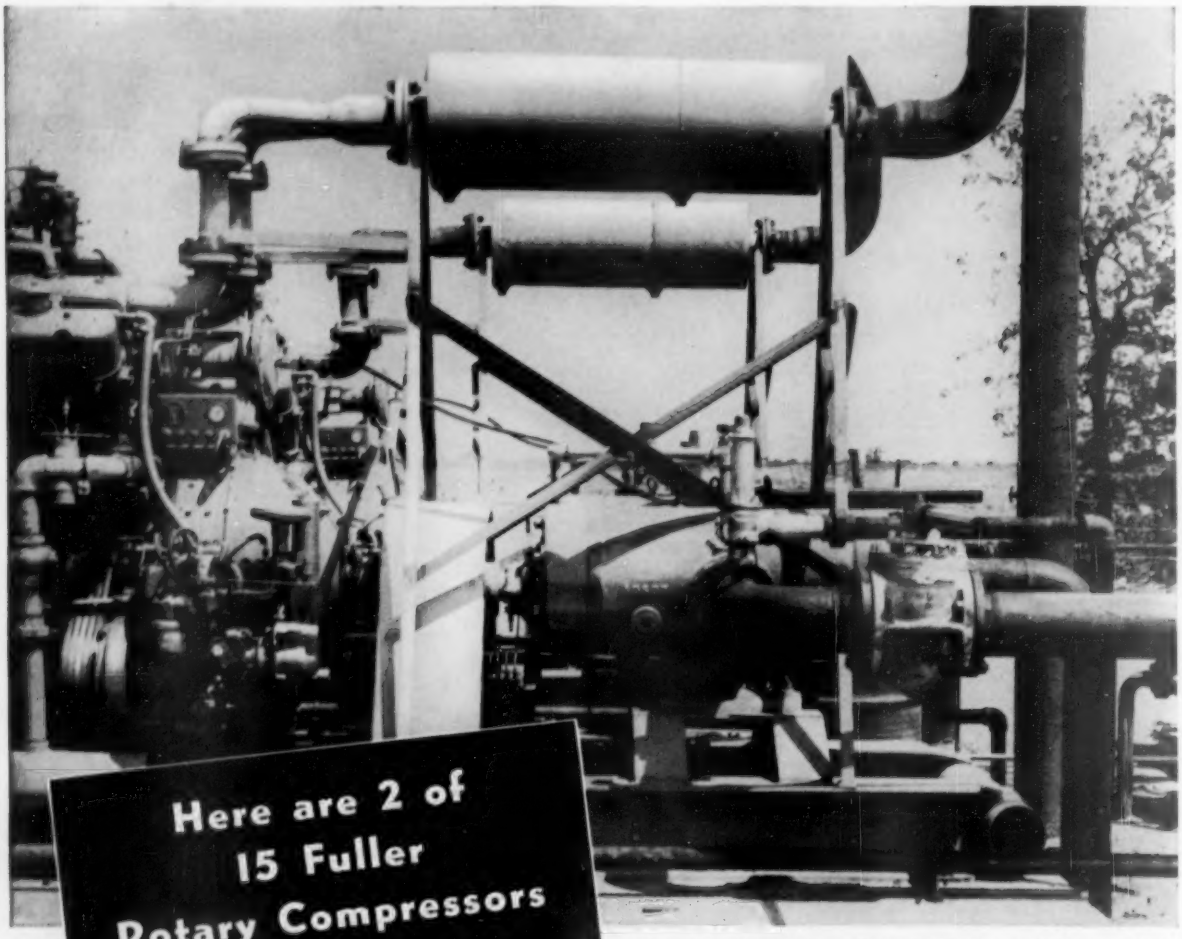

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PERSONALS

Neath Moves Up

Humble veteran to succeed Barrow as board chairman

JASPER A. NEATH, known affectionately as "Jap" by everyone from lease pumpers to oil-company presidents, becomes chairman of the board of Humble Oil & Refining Co. June 1. He will succeed L. T. Barrow, who is retiring.

A native of Red Rock, Pa., Neath joined a pipeline-connection gang working for The Texas Co. at the age of 16. He's been a part of the oil industry since then and has spent more than 40 years acquiring the label "an oil man's oil man." Thirty-six of those years he's been climbing Humble's ladder.

Affable by nature and unobtrusive in appearance, "Jap" enjoys the respect and affection of equals and subordinates alike to a degree that is unusual for a top business executive.

"Jap knows how to get along with people and how to get people to work with him," an associate said last week after his latest promotion was revealed.

He started acquiring those executive attributes in his rough-and-ready pipelining days when the industry was still in its infancy and when he was little more than a boy himself.

After his youthful stint with The Texas Co., Neath worked for Gulf Oil Corp. and then joined the old Southern Pipe Line Co. in 1918. When Humble Pipe Line Co. took over Southern a year later, Neath was a district foreman in the booming Ranger, Tex., area.

He became division superintendent of Humble Pipe Line in Cisco, Tex., and in 1924, at the venerable age of 28, he was moved to Houston as superintendent of the entire pipeline system. From that moment on, Neath moved from one executive job to another—and always up.

He was elected to the board of the pipeline company in 1925 and became a vice president in 1928. He remained with the pipeline company until 1942, when he resigned his vice presidency to become a director of the parent company, Humble Oil & Refining.

Five years later he was named one of Humble's vice presidents and given duties that might have swamped a lesser man. He was vice president and director in charge of transportation and crude-oil marketing. He had the direction of the purchasing department, crude-oil sales and purchases, the marine department, the traffic bureau, the home-office building, company public relations, and the coordination of affairs with Humble Pipe Line.

Active in oil-industry association work, Neath was given a distinguished service award in 1951 by the Texas Mid-Continent Oil and Gas Association. This association work, plus the fact that he directed crude sales and purchases for Humble, has made Neath well known throughout the Southwest.

"He probably knows more independent oil operators than any man in Texas," an associate said last week.

An accomplished golfer, Neath has mastered the game well enough to collect at least one trophy for his play in a Texas Mid-Continent Association match. His golf and a summer home on Galveston Bay occupy the time he does not devote to business, civic affairs, and his family. Neath and his wife have two sons, Robert, a Corpus Christi chemical engineer with Humble, and Jack, a Houston insurance man, and six grandchildren.

Neath is a director and member of the executive committee of the Houston Chamber of Commerce, a member of the board of directors of St. Luke's Episcopal Hospital in Houston, and a member of the Houston Petroleum Club, Houston Club, Dallas Petroleum Club, and Austin Club, among others.

John A. Barnett, Jr., geologist for Seaboard Oil Co. in Midland, Tex., for more than 2 years, has resigned to become a consultant.

Donald A. Moore, research chemical engineer with Esso Standard Oil Co., has resigned to accept a similar position with Monsanto Chemical Co. at Everett, Mass.

Richard L. Zimmermann, former petroleum engineer with Houston Oil Co. of Texas at Silsbee, Tex., has resigned and joined Panhandle Eastern Pipe Line Co. at Liberal, Kans., as assistant gas reservoir engineer.

J. W. Schmid has been elected vice president and director of West Coast Refining Co. and the Arrowhead Oil Co. Arrowhead produces oil in the Placentia - Atwood area in California. West Coast Refining Co. operates a natural-gasoline plant which processes most of the gas produced in the area.

W. G. MOORE

W. G. Moore, assistant to the president of Gulf Oil Corp. for more than 20 years, has retired. Moore's activities were concerned mostly with the economics and coordination of the firm's major operations. Recently he has been helping to develop the company's petrochemical interests. He had served three presidents, **J. Frank Drake, S. A. Swensrud,** and **W. K. Whiteford,** the current president.

J. E. Roth, vice president and general manager of the central division of Tide Water Associated Oil Co. at Tulsa, has been elected to the board of directors of the American Petroleum Institute. He succeeds **E. H. Salrin,** retired vice president of Tide Water.

L. C. Kemp, Jr., has been named general manager of The Texas Co.'s newly established petrochemical department. Kemp joined Texaco in 1929 as a research chemical engineer at the Port Arthur, Tex., refinery. He has served in various capacities in the research field and was director of research from 1941 to 1953.

David P. Parker has been appointed manager of the Brooklyn refinery of Socony Mobil Oil Co., Inc., effective June 1. He succeeds **Dr. William L. Linton,** who has been manager of the refinery since 1938. Parker is a veteran of 21 years with Socony and has served at its refineries in Augusta, Kans., and East St. Louis, Ill. He also served as manager of Socony's British affiliate,

PERSONALS

Vacuum Oil Co., when the firm was building its recently completed refinery at Coryton.

W. D. Chawner, district geologist with Carter Oil Co., has been transferred from Bowling Green, Ky., to Durango, Colo.

George P. McBride has joined Freeport Sulphur Co.'s new oil and gas division office in Midland, Tex., as manager. Before joining Freeport last year, he worked 7 years with Standard Oil Co. of Texas, Texas Gulf Producting Co., and Louisiana Land & Exploration Co.

W. H. Peachee and **Glen Davis** have formed Oil Propery Management, Inc., in Wichita. The firm will offer a complete management service to owners of producing properties. Peachee is a veteran of the oil-supply industry. Davis has served with Continental Oil Co., Gulf Oil Corp., and Republic Natural Gas Co.

Dr. M. King Hubbert, Houston, chief consultant in geology for Shell Oil Co., has been elected to the National Academy of Sciences, the nation's highest scientific tribunal. Hubbert has been with Shell since 1943 and is recognized as one of the oil industry's leading authorities on the hydrodynamics of underground fluids.

Sam W. Hogan, production superintendent with Midwest Oil Corp., Fort Worth, has resigned to enter the petroleum consulting field in Fort Worth. Hogan began his oil career with the Slick Interests in 1933. He served Slick as an engineer and production superintendent in Oklahoma, Kansas, Texas, Colorado, New Mexico, and Louisiana until he resigned in 1951.

Harry L. Franklin, former petroleum engineer with DeGolyer & MacNaughton, of Dallas, has resigned to join Harry Bass Drilling Co., of Dallas, as production superintendent in the headquarters office. Franklin had served as DeGolyer & MacNaughton's engineering representative in Rio de Janeiro, Brazil.

J. Robert Nelson has resigned as drilling equipment specialist for Continental Oil Co. to join Bass Drilling as a mechanical engineer at Dallas.

West Coast Group Elects Officers for 1955-56

The Pacific Coast District, Division of Production, of the American Petroleum Institute elected its officers for the 1955-56 year at its recent meeting in California. Officers elected were, standing left to right, Irv Dagan, Standard Oil Co. of California, vice chairman, Coalinga-Kettleman; John Bell of Humble Oil & Refining Co., vice chairman, advisory committee; H. H. Carrick, Jr., General Petroleum Corp., vice chairman, Los Angeles Basin; J. J. Oliphant, General Petroleum Corp., vice chairman, San Joaquin Valley; Don Sweet, Richfield Oil Corp., vice chairman, Coastal area; (seated) Sam Grinsfelder, Union Oil Co., vice chairman, advisory committee; O. A. Graybeal, Sunray Oil Corp., chairman, Pacific Coast district; Mrs. Elsie Edmiston, secretary; and Chas. T. Reichert, National Supply Co., treasurer.

Bob Maresh and **Jim Atkinson,** former geologists with Pure Oil Co., have opened geological consulting offices in Denver.

C. I. Wall has been elected president of Pioneer Natural Gas Co., Amarillo, Tex. Wall, former executive vice president, succeeds **George Baird.**

C. F. (Doc) Maginnis has joined Lago Petroleum Co. in Houston as a geologist for the Texas Gulf Coast and South Louisiana areas. Maginnis has been with Midstates Oil Corp. the past 9½ years.

R. E. Hammond, production staff assistant of Carter Oil Co.'s eastern division at Mattoon, Ill., has been named division production manager. Hammond, who joined Carter in 1937 as a laborer in Seminole, Okla., has been staff assistant at Mattoon since July 1953. **Irvin Alexander,** district superintendent at Carmi, Ill., since 1949, has been named to replace Hammond at Mattoon. Other changes announced by Carter are **H. W. McCormick,** district superintendent of the Vernal, Utah, district, transferred as district superintendent of the Carmi district; **B. M. Bradley,** assistant superintendent of the St. Elmo, Ill., district, named superintendent of the Vernal district; **J. L. Wible,** district engineer at Jackson, Miss., advanced to assistant district superintendent of the St. Elmo district; **R. M. Pitcher,** senior engineer at Magnolia, Ark., named district engineer at Jackson; **J. L. Barthel,** acting district foreman at Purcell, Okla., advanced to assistant district superintendent at Purcell; and **R. D. Orr,** acting district engineer at Purcell, promoted to district engineer there.

George V. Holton, chief executive officer of Socony Mobil Oil Co., Inc., will retire July 1 as chairman of the board. Holton made the announcement at the company's annual stockholders' meeting. During the meeting the stockholders voted to change the name from Socony-Vacuum Oil Co., Inc., to Socony Mobil.

Lewis W. Douglas and **P. Malozemoff** have been elected to the board of directors of Continental Oil Co. Douglas has been president or chairman of the board of Mutual Life Insurance Co. of New York since 1940, except from February 1947 to December 1950, when he served as ambassador to the Court of St. James. He is also a director of numerous corporations, including General Motors and International Nickel. Malozemoff replaces **Charles F. Ayer,** who has retired after 26 years as a Conoco director. Malozemoff is president of Newmont Mining Corp. and

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PERSONALS

has had wide experience in the mining industry in the United States, Alaska, Costa Rica, and South America.

A. M. Shook has been promoted to division petroleum engineer of the South Texas division by The Texas Co. Shook joined Texaco as a roustabout in 1937 while still in college at Texas A. & M. He advanced to petroleum engineer before World War II. After 4 years war service, he returned to the division office at Houston. Since then he has served as district petroleum engineer at Freer, Tex., and in various positions in the Houston office.

K. W. Minix has joined Dow Chemical Co.'s Texas division at Freeport as a chemist in the light hydrocarbon department. **G. E. Gaumer** has joined the firm there as a chemist in the organic process development laboratory.

Jerry D'Arcy has been promoted to vice president in charge of Canadian operations by Arrow Drilling Co. of Canada, Ltd. D'Arcy has been serving as manager of the firm's Canadian operations since October 1954. Before going to Canada, he had served in the Oklahoma-North Texas division of Arrow Drilling Co.

John R. Harnish, geologist with Phillips Petroleum Co., has been transferred from Emporia, Kans., to Grand Junction, Colo.

Gustave L. Hoehn, Jr., senior research electrical engineer at Magnolia Petroleum Co.'s field research laboratories at Dallas, and **Phillip S. Landis,** senior research chemist at Socony Mobil Oil Co., Inc., laboratories at Paulsboro, N. J., have been named winners of Socony's 1955 incentive fellowships. Socony established the annual fellowships in 1947 to improve the academic training of laboratory employes who have shown more than usual ability and proficiency in science and inventiveness. Hoehn will work on his doctor's degree in electrical engineering at Stanford University, Palo Alto, Calif., and Landis will seek a doctorate in chemistry at Northwestern University.

Eldon V. Hunt, chief engineer of the Alberta Gas Trunk Line Co., Ltd., Calgary, has left for Pakistan to assist in building the Sui Gas Transmission Co., Ltd.'s pipeline across the Indus River.

Nolla Spaugh, Michigan district foreman for Sohio Petroleum Co., has retired after 11 years with the company. **E. O. Daugherty,** who had been serving as assistant district foreman, has succeeded Spaugh.

Glover H. Cary, Jr., has been named a safety engineer by Texas Transmission Corp. Carey had been serving as a foreman in the company housing department since July 1952.

I. D. Hall and **P. N. Kuehler** have been promoted to technical associates in the technical service division at Humble Oil & Refining Co.'s Baytown, Tex., refinery. **C. J. G. Leesemann** has been named a research associate in the research and development division. Hall was selected in 1944 to head the technical staff of the government-owned butadiene plant at the refinery and for 8 years served as head of various sections in technical service. Kuehler has held various supervisory positions in the technical and research divisions. Leesemann is chairman of the refining patent committee, handling technical aspects of patent and legal matters.

Lou G. Cornish has joined the exploration staff of Statex Petroleum Co., Midland, Tex. Cornish, a veteran of 23 years with Seismograph Service Corp., Tulsa, was vice president and chief geophysicist for one of its subsidiaries when he resigned.

George Hinckley of Utah Oil Refining Co., Salt Lake City, has been elected chairman of the refining division of the Rocky Mountain Oil and Gas Association. He succeeds **Harry A. Brown,** vice president of Frontier Refining Co., who was elected counselor. **J. A. Ramsey,** Continental Oil Co., Billings, Mont., was named vice chairman.

Flavy E. Davis has joined Rycade Oil Corp. as general manager with headquarters in Houston. Davis resigned as vice president and general manager of J. Ray McDermott Co. to go with Rycade. Davis also once served as manager of exploration for American Republics Corp.

DEATHS

J. O. Mack, 70, president of Houston, Texas Oil & Gas Co., died May 7 in Houston after a 2-month illness. Mack had been a Gulf Coast operator more than 30 years. At the time of his death, he was promoting a natural-gas transmission line from Texas via the eastern seaboard to eastern industrial centers. In March, the firm announced plans for a gas line from the Mississippi River to Miami, Fla. The firm would have received its gas from another line planned from southern Texas to the Mississippi.

William Bullitt Fitzhugh, 58, president of Fitzhugh Petroleum Co., Dallas, died at his home there recently.

Norman L. Stevens, southwestern Michigan oil producer, died May 5 in Winsted, Conn., after a long illness.

Jack Foster, 49, executive with Sunset Oil Co. at Pomona, Calif., died there recently after suffering a heart attack.

O. G. Murphy, 73, retired El Dorado, Ark., oil man, died recently at Hot Springs, Ark., after suffering a heart attack.

L. E. Dutton, Houston drilling contractor, died May 10 in a fire at his home there. Authorities attributed his death to suffocation from smoke or a heart attack. He established his drilling company several months ago. He formerly was associated with PLD Oil Well Drilling Service.

Frank G. Helscel, 73, pioneer Tulsa oil man, died at his Tulsa home May 7 of a kidney ailment. Helscel moved to Tulsa in 1917 from Pennsylvania, where he had been a wildcatter and driller for many years. He was associated with John H. Markham and Harry Sinclair after coming to Oklahoma.

Clarence W. Sharrai, 60, superintendent for Tide Water Associated Oil Co. in South Texas the past 14 years, died recently after suffering a heart attack on a well location in Brazoria County. Sharrai joined Tide Water in 1931.

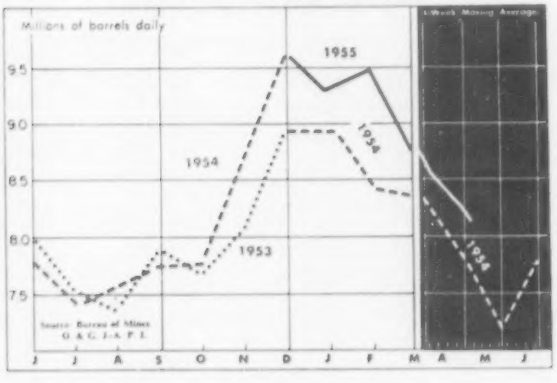
Roy J. Miller, 56, former executive with the Julius Hyman Chemical Co. before it was bought by Shell Chemical Co. 2 years ago, died recently in Denver from injuries received in a traffic accident.

Latest Figures . . . Industry Trends

A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	6,706,725	DOWN	132,575	UP	243,825
Crude stocks	274,976,000	UP	2,195,000	UP	973,000
Completions	1,083	DOWN	2	UP	78
Refinery runs	7,029,000	DOWN	130,000	UP	218,000
Gasoline stocks	174,243,000	DOWN	2,516,000	DOWN	1,631,000
Distillate stocks	70,551,000	UP	2,916,000	UP	6,622,000
Four-product stocks	310,294,000	UP	1,001,000	UP	5,603,000
Total imports	1,151,700	UP	102,600	UP	81,300

TOTAL DEMAND – ALL OILS



High Level of Industrial Activity Supports Residual Fuel Markets

RESIDUAL fuel has more strength on the open market today than any other major petroleum product. There are several contributing factors, but the big reason is increased demand for heavy fuel due to the high level of industrial activity.

Demand for residual fuel in the first 2 months of this year was almost 7 per cent greater than for the same months of 1954. Most of this increase was due to colder weather. Very little gas was available for customers with interruptible contracts, and some of this demand shifted to residual fuel. Domestic demand for the period was up almost 7 million barrels. Increased consumption by electric power plants accounted 2.4 million of the increase.

Production of residual fuel at refineries for the first 2 months of the year was 1.6 per cent less than last year despite an increase of 6.5 per cent in refinery runs. The difference was made up by increased imports and larger withdrawals from stocks. Resid stocks dropped 6 million barrels in the January-February period this year compared with a reduction of 2.2 million last year.

Residual stocks at the first of the year stood about 3 million barrels above the year-earlier level. Currently, stocks are about the same as last year.

The residual demand chart on the last page of the statistics section shows that total demand for heavy fuel at the end of April was running about 100,000 bbl. daily above last year. This gain over last year takes on more importance when compared with the general downward trend in residual demand in recent years. Domestic demand for residual in 1954 was down 6.8 per cent from 1953 and was 5.7 per cent less than demand in 1950.

Current residual demands are related to industrial production. The adjusted FRB index of industrial production for the first quarter of this year averaged slightly better than 133 compared with 124 for the first quarter of last year. Since industrial production last year remained at about the first-quarter level until October, there is a good chance that second and third-quarter averages this year will be above the same quarters last year.

If residual demand for these quarters fails to top last year's average, the loss can be charged to lack of supply rather than a drop in potential demand.

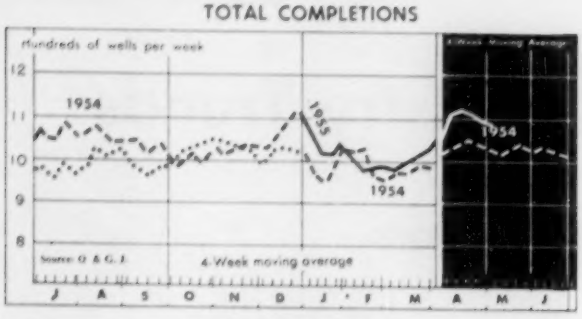
The only surplus residual available now is in California, and it takes a long haul to move this material to the high-demand areas on the East Coast. Residual stocks on the West Coast at the end of the year were higher than at any year end since 1949.

Total residual stocks on the West Coast reached 29.4 million barrels at the end of 1954 or 56.5 per cent of all residual in the country.

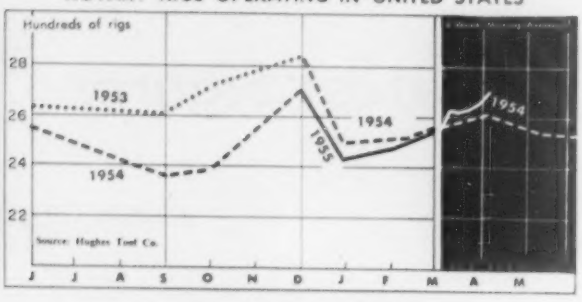
Shipments of residual from California to the East Coast amounted to almost 2 million barrels in the first 2 months of this year. By the end of April, residual stocks on the West Coast had dropped to 23.8 million barrels or 54 per cent of the national total.

To make this West Coast material available on the East Coast means a low netback to the West Coast refiner. Normal postings on the West Coast average about $1.80 per barrel, but barge deliveries in New York bring only $2.35 and transportation cost is almost $1.00.

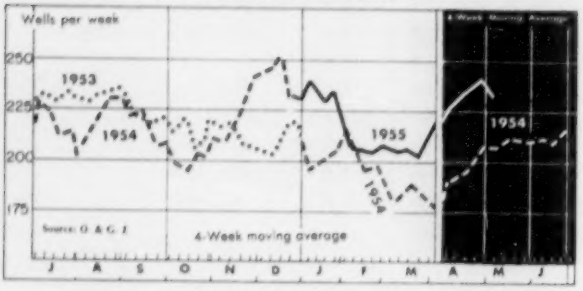
TOTAL COMPLETIONS



ROTARY RIGS OPERATING IN UNITED STATES



WILDCAT COMPLETIONS



ACTIVE ROTARY RIGS*

Area—	5-9-55	Change from 5-2-55	Change from 5-10-54
Gulf Coast	571	8	10
N. and W. Texas-New Mexico	887	9	74
Arkansas-N. Louisiana-E. Texas	164	4	— 9
Oklahoma	347	—10	— 5
Kansas-S. Nebraska	195	1	31
Illinois-Eastern	173	30	43
Rocky Mountain	221	12	—27
Pacific Coast	147	— 5	5
Total United States	2,705	49	122
Western Canada	77	— 8	—35

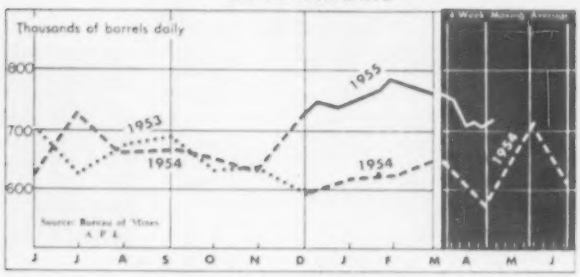
*Hughes Tool Co.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED MAY 7, 1955

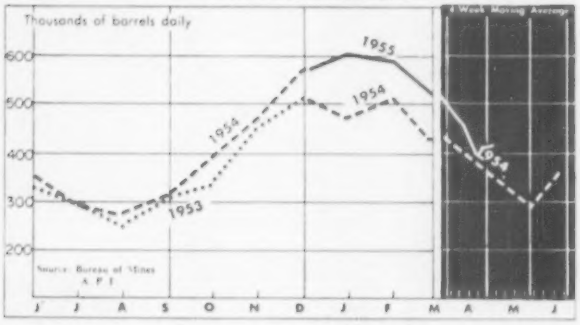
	Total of all wells							Wildcat completions and discoveries										
						Cum.							Cumulative total, 1955					
	Comp.	Oil	Gas	Dry	Footage	1955	1954	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
Ala.-Ga.-Fla.	2	0	0	2	10,391	37	41	0	0	0	1	1	0	0	0	35	35
Arkansas	13	8	0	5	37,361	232	214	0	0	0	4	4	13	0	0	62	75
California	50	39	2	9	268,810	892	871	1	0	1	7	9	13	0	3	124	140
Colorado	30	8	0	22	154,719	460	429	0	0	0	17	17	16	0	10	233	259
Illinois	79	48	0	31	203,655	1,226	926	3	0	0	11	14	23	0	1	188	212
Indiana	7	4	0	3	12,003	252	286	1	0	0	0	1	7	0	0	116	123
Kansas	102	57	7	38	366,920	1,738	1,500	2	0	1	12	15	43	1	13	267	324
Kentucky	26	10	0	16	34,744	422	376	0	0	0	6	6	12	0	5	66	83
Louisiana	67	48	2	17	362,621	1,290	1,074	0	1	1	6	8	40	31	10	122	203
North	39	35	1	3	108,945	671	566	0	0	0	2	2	7	3	1	49	60
South	28	13	1	14	253,676	619	508	0	1	1	4	6	33	28	9	73	143
Michigan	12	3	0	9	26,309	178	193	0	0	0	6	6	5	0	0	70	75
Mississippi	14	6	0	8	113,251	166	126	0	0	0	7	7	4	0	0	59	63
Montana	5	4	0	1	32,025	103	94	1	0	0	0	1	2	0	1	31	34
Nebraska	3	2	0	1	15,728	205	116	0	0	0	0	0	14	0	0	78	92
New Mexico	40	21	9	10	153,865	469	390	1	0	0	4	5	15	1	3	36	55
Northwest	11	0	7	4	21,387	120	123	0	0	0	3	3	1	0	3	11	15
Southeast	29	21	2	6	132,478	349	267	1	0	0	1	2	14	1	0	25	40
North Dakota	6	5	0	1	39,820	75	83	0	0	0	0	0	0	0	0	12	12
Ohio	23	11	1	*11	46,455	363	389	0	0	0	0	0	1	0	2	9	12
Oklahoma	176	107	12	†57	542,928	2,981	3,186	2	0	0	15	17	49	7	14	220	290
Pennsylvania-New York	26	9	8	‡9	57,341	516	847	0	0	0	0	0	0	0	5	3	8
Texas	374	237	7	130	1,496,940	6,725	6,181	15	2	0	76	93	263	40	45	1,408	1,756
Southwest (1 & 4)	60	30	2	28	233,973	1,078	879	2	0	0	16	18	37	10	16	273	336
Gulf Coast (2 & 3)	48	21	1	26	298,217	895	915	4	2	0	17	23	32	25	16	225	298
East (5 & 6)	14	5	0	9	46,899	333	311	0	0	0	3	3	11	2	1	108	122
North Central (7-B & 9)	153	90	1	62	421,027	2,368	2,348	6	0	0	37	43	129	0	2	548	679
West (7-C & 8)	77	74	0	3	406,709	1,705	1,416	2	0	0	2	4	51	1	6	247	305
Panhandle (10)	22	17	3	2	90,115	346	312	1	0	0	1	2	3	2	4	7	16
Utah	4	3	0	1	18,494	25	22	0	0	0	1	1	2	0	2	14	18
West Virginia	10	0	7	3	25,415	203	193	0	0	0	0	0	0	0	3	8	11
Wyoming	14	10	0	4	66,896	271	510	0	0	0	2	2	6	0	3	49	58
Miscellaneous	0	0	0	0	0	15	76	0	0	0	0	0	0	0	0	13	13
Total United States	1,083	640	55	388	4,086,691	18,844	18,123	26	3	3	175	207	528	80	120	3,223	3,951
Total previous week	1,085	587	71	427	4,295,490			29	9	5	196	239	502	77	117	3,048	3,744
Total May 8, 1954	1,005	568	59	378	3,960,396			23	0	8	170	201	472	50	117	3,011	3,650
Western Canada	23	9	1	*13	114,104												

Service wells included *1, †3, ‡7.

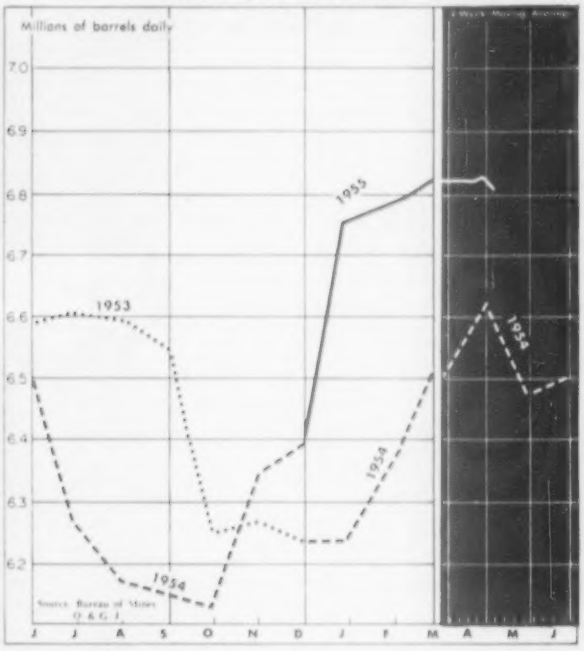
CRUDE IMPORTS



PRODUCT IMPORTS



CRUDE OIL PRODUCTION

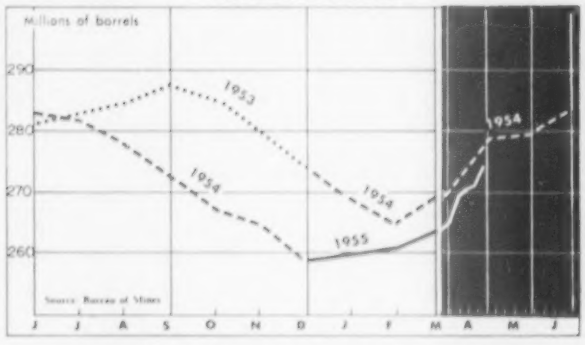


DAILY AVERAGE PRODUCTION FOR WEEK

	May 7 Crude oil	May 7 Lease condensate	May 7 Total	April 30 total
Alabama	4,300		4,300	4,200
Arkansas	74,800	500	75,300	75,650
California	976,800		976,800	975,700
Colorado	140,800		140,800	141,300
Eastern	46,500		46,500	46,500
Florida	1,350		1,350	1,325
Illinois	221,900		221,900	221,400
Indiana	28,400		28,400	27,900
Kansas	327,300		327,700	328,400
Kentucky	39,100		39,100	39,700
Louisiana	675,500	53,050	728,550	723,150
North	111,500	3,050	114,550	114,800
South	564,000	50,000	614,000	608,350
Michigan	32,200		32,200	31,100
Mississippi	91,975	4,700	96,675	95,850
Montana	44,100		44,100	43,800
Nebraska	29,400		29,400	29,700
New Mexico	227,600	4,150	231,750	230,425
North Dakota	28,100		28,100	28,800
Oklahoma	550,400		550,400	557,200
Texas	2,761,000	50,300	2,811,300	2,943,900
Dist. 1	53,600	600	54,200	54,575
Dist. 2	139,700	8,200	147,900	158,800
Dist. 3	427,000	22,800	449,800	468,000
Dist. 4	232,500	5,475	237,975	249,500
Dist. 5	45,500	475	45,975	47,500
Dist. 6	118,000	5,450	123,450	130,200
East Texas field	213,000		213,000	231,200
Dist. 7-B	139,000	50	139,050	141,050
Dist. 7-C	185,400	4,350	189,750	199,500
Dist. 8	912,800	2,000	914,800	968,700
Dist. 9	207,000	775	207,775	207,750
Dist. 10	87,500	125	87,625	87,125
Utah	6,300		6,300	6,200
Wyoming	285,900		285,900	286,700
Others	‡300		‡300	400
Total U. S.	6,594,025	112,700	**6,706,725**	6,839,300
Change from prev. week, down			**132,575**	
Canada	†203,150		†203,150	†257,025
Total U.S. production January 1-May 7				858,689,250 bbl.
Same period last year (crude plus cond.)				*817,438,360 bbl.

*Includes 13,200,175 bbl. condensate. †Week ended previous Monday. ‡S.D. 100, Nev. 200.

CRUDE OIL STOCKS



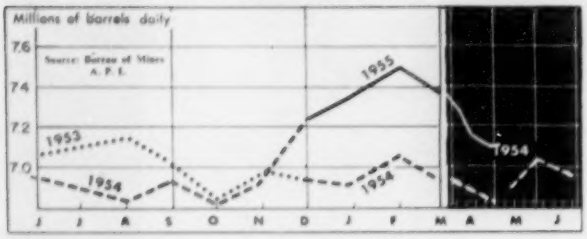
CRUDE-OIL STOCKS BY STATES OF ORIGIN*
(Thousands of barrels)

	Apr. 30, '55	Apr. 23, '55	May 1, '54
Pennsylvania Grade	2,812	2,874	3,150
Other Appalachian	2,011	2,124	1,829
Illinois, Indiana, Michigan	11,591	11,069	12,455
Nebraska, North Dakota	2,375	2,525	(‡)
Kansas	8,416	8,575	9,781
Oklahoma	25,171	25,402	27,004
Arkansas	2,914	3,050	3,555
Louisiana	15,450	15,526	16,336
North	2,482	2,522	2,506
South	12,968	13,004	13,830
Mississippi	2,869	2,894	3,287
New Mexico	8,901	8,717	7,598
Texas	127,569	125,747	126,645
East Texas proper	10,597	10,140	11,677
West Texas	56,227	55,691	54,512
Texas Gulf	25,179	25,325	26,460
Other Texas	35,566	34,591	33,996
Wyoming	15,351	15,074	14,229
Other Rocky Mountain	5,467	5,608	3,777
California	32,268	32,453	33,898
Foreign	†11,811	11,143	10,459
Total	274,976	272,781	274,993

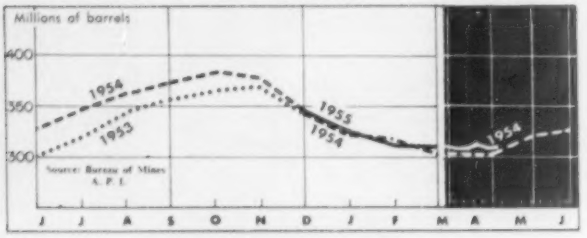
*Bureau of Mines. †Includes 2,637,000 bbl. in California. ‡Included with Kansas.

CURRENT DATA ON RUNS AND PRODUCTION ARE 4-WEEK AVERAGES

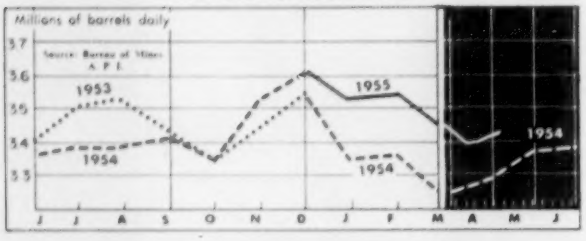
REFINERY RUNS



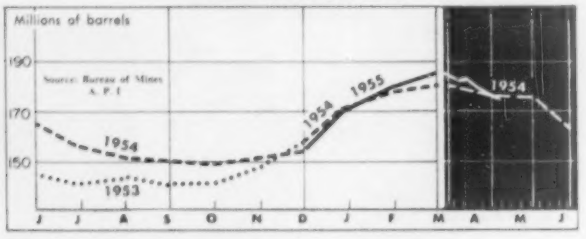
FOUR-PRODUCT STOCKS



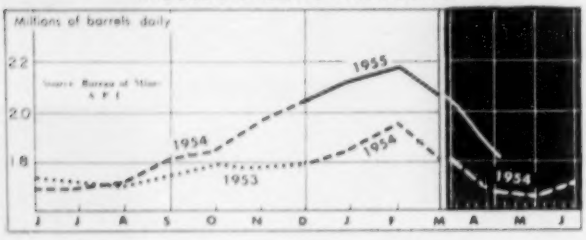
GASOLINE PRODUCTION



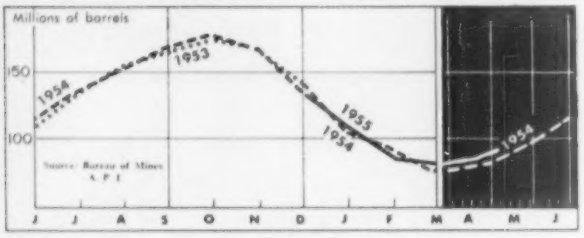
GASOLINE STOCKS



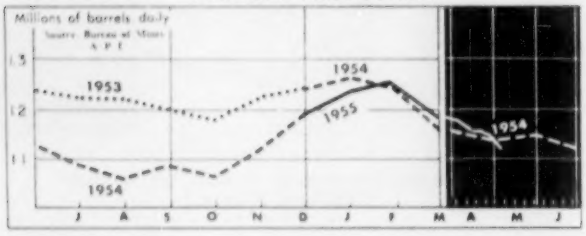
MIDDLE-DISTILLATE PRODUCTION



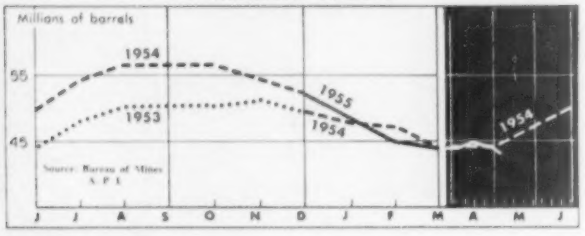
MIDDLE-DISTILLATE STOCKS



RESIDUAL PRODUCTION



RESIDUAL STOCKS



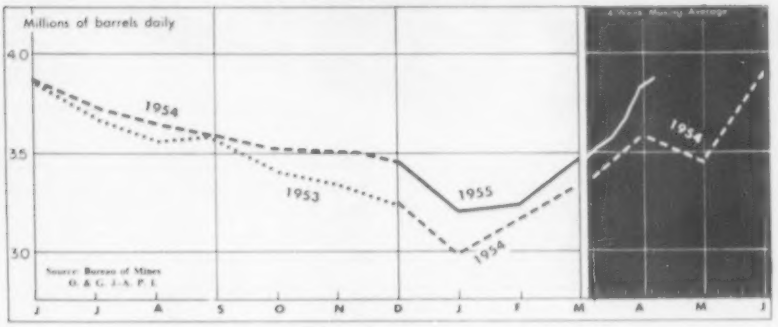
A.P.I. REFINERY REPORT, MAY 6

(Thousands of barrels)

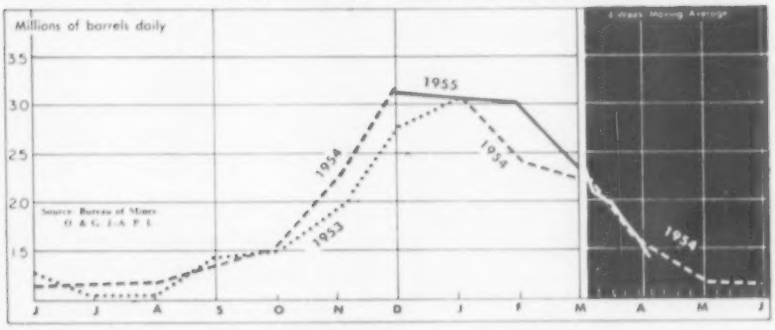
District—	Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.	Stocks‡ Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, May 1954 Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.
East Coast	879	373.0	32.1	224.3	189.4	37,987	9,268	23,974	8,110	1,038	412.8	28.9	216.9	206.7
Appalachian:														
District 1	97	42.6	3.1	24.3	7.1	5,118	464	1,605	297	106	47.2	3.6	22.6	7.8
District 2	74	47.4	0.6	14.6	10.6	2,673	326	630	157	82	48.5	4.2	10.6	10.4
Ind., Ill., Ky.	1,344	698.2	68.0	247.3	160.3	36,889	4,889	12,292	3,536	1,299	658.3	69.0	234.1	161.1
Okla., Kans., Mo.	629	316.2	19.1	149.0	36.3	17,370	1,163	7,709	845	617	334.8	18.3	126.9	43.3
Inland Texas	252	176.7	12.4	33.3	20.7	6,614	401	1,157	1,270	243	177.9	9.6	43.3	26.8
Texas Gulf Coast	1,745	810.7	90.2	385.8	227.3	23,180	2,638	7,948	3,855	1,674	805.9	98.1	345.6	216.3
La. Gulf Coast	593	319.4	47.9	159.7	33.7	10,712	1,587	3,780	1,222	567	281.7	50.4	139.9	46.1
N. La. and Ark.	84	32.7	10.0	19.8	6.4	4,009	906	1,244	87	88	36.0	7.7	20.5	7.3
Rocky Mountain:														
New Mexico	19	11.3	1.0	3.0	2.9	186		83	32	18	11.7	4	3.2	2.4
Other Rocky Mt.	242	112.1	6.0	60.6	33.6	7,731	223	1,931	711	247	115.9	3.5	55.1	34.7
California	1,071	482.4	6.0	150.7	347.4	21,774	330	8,198	23,183	1,059	446.1	7.9	153.3	384.9
May 6, 1955	7,029	3,422.7	296.4	1,472.4	1,075.7	174,243	22,195	70,551	43,305	7,038	3,376.8	301.6	1,372.0	1,147.8
April 29, 1955	7,159	3,442.7	303.7	1,503.0	1,113.7	176,759	21,012	67,635	43,887					
May 7, 1954	6,811	3,237.1	267.4	1,365.3	1,145.0	175,874	20,210	63,939	44,668					

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit and in pipelines.

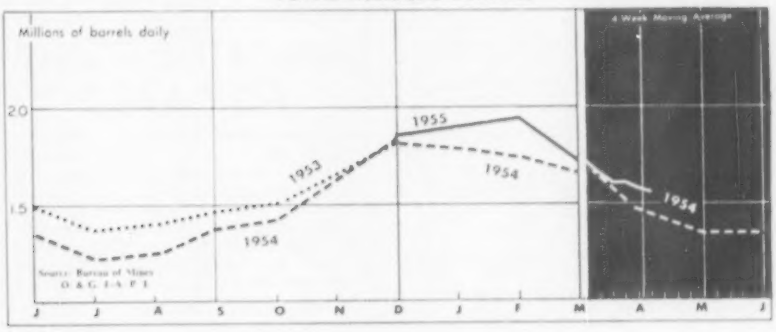
TOTAL GASOLINE DEMAND



TOTAL MIDDLE-DISTILLATE DEMAND



TOTAL RESIDUAL DEMAND



REPRESENTATIVE QUOTATIONS

Spot-market quotations of leading suppliers as of May 11, 1955. Prices are in cents per gallon, except for residual in dollars per barrel and wax in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Texas Gulf Coast
Regular gasoline	10.75-11.25	11.25-12	10.25-10.75
Premium gasoline	12-12.5	13-13.75	11.50-11.75
42-44 w.w. kerosine	9.5-9.75	10.05	8.75-9.0
No. 2 straw fuel oil	8.75-9.0	9.3	8.25-8.5
No. 6 residual	$1.60-1.65	$2.35-2.45	$1.95-2.00

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	4.5	4.0	4.25
Grade 18-55	5.4	4.9	5.15

LUBRICATING OILS

Mid-Continent

150-160 vis., D bright stock, 0-10 pp.	18
200 vis., No. 3 neutral, 0-10 pp.	13.25

WAX

Mid-Continent

132-134 A.M.P.	6.0

• Gasoline tank-wagon prices have been raised in the North Central states. Regular grade did not change in Chicago and a few other points, but most raises ranged from 0.3 to 0.5 cent a gallon. Premium gains ranged from 0.5 to 1.0 cent. Some Group 3 regular is still selling for 10.75 cents. Light fuels are off 0.25 cent on the Gulf Coast.

PRODUCTION AND DEMAND — MAJOR PRODUCTS

(Thousands of barrels)

	Refinery prod.	Total demand
Gasoline:		
Four weeks ended 5-6-55	3,430	3,870
February 1955	3,655	3,243
March 1954	3,261	3,331
April 1954	3,298	3,547
Middle distillate:		
Four weeks ended 5-6-55	1,810	1,387
February 1955	2,221	3,036
March 1954	1,811	2,235
April 1954	1,696	1,592
Residual fuel:		
Four weeks ended 5-6-55	1,120	1,566
February 1955	1,239	1,956
March 1954	1,169	1,664
April 1954	1,141	1,479

CRUDE PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.*	Okla-homa, Kansas	Gulf Coast Tex.†	West Tex.‡
14-14.9	$1.87			
15-15.9	1.93			
16-16.9	1.99			
17-17.9	2.05			
18-18.9	2.11			
19-19.9	2.18			
20-20.9	2.24	$2.50		$2.37
21-21.9	2.30	2.52		2.39
22-22.9	2.37	2.54		2.41
23-23.9	2.45	2.56		2.43
24-24.9	2.53	2.58	$2.91	2.45
25-25.9	2.61	2.60	2.93	2.47
26-26.9	2.69	2.62	2.95	2.49
27-27.9	2.76	2.64	2.97	2.51
28-28.9	2.83	2.66	2.99	2.53
29-29.9	2.91	2.68	3.01	2.55
30-30.9	2.97	2.70	3.03	2.57
31-31.9	3.04	2.72	3.05	2.59
32-32.9	3.12	2.74	3.07	2.61
33-33.9		2.76	3.09	2.63
34-34.9		2.78	3.11	2.65
35-35.9		2.80	3.13	2.67
36-36.9		2.82	3.15	2.69
37-37.9		2.84	3.17	2.71
38-38.9		2.86	3.19	2.73
39-39.9		2.88	3.21	2.75
40 and above		2.90	3.23	2.77

*Standard Oil Co. of California. †Upper Texas Gulf Coast. ‡Sour. Includes New Mexico Permian.

Effective dates: California, February 16, 1953; east of California, June 15, 1953; Pennsylvania Grade, January 21, 1955.

FLAT CRUDE PRICES

Representative posted schedules per barrel.

Louisiana:	
Cotton Valley (distillate)	$3.00
Cotton Valley (Holloway crude)	2.95
Texas:	
East Texas	2.90
Chapel Hill	2.83
Conroe	3.13
Van	2.73
Pennsylvania Grade:	
Bradford	3.50
Middle District	3.37
Southwest Pennsylvania	3.08
West Virginia	2.97
Buckeye Grade	2.91
Zanesville Grade	2.72
Illinois Basin	2.90

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SALES AND RENTALS. Used cable drilling and fishing tools, casing, production equipment; from the Southwest's largest stock of oil field supplies. Degen Pipe and Supply, Tulsa.

FAILING 2500 Trailer mounted. Also Failing 1500 Truck mounted. Both rigs complete with drill pipe, winch trucks, and tools. For inventory of equipment, and price, write M & G Drilling Co., P. O. Box 42, Guymon, Okla.

FOR SALE—Horizontal Duplex Steam Pumps—10x8½x12—353 GPM—bronze fitted—max. discharge pressure 100 lbs.—6" suction—5" discharge—mfg. by American Marsh Co. Quantity available—NEW—Boston Metals Co. 313 E. Baltimore St., Baltimore 2, Md., Curtis 7-5050.

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#527—Franks Model 44-TM, Single Drum, Truck Mounted Servicing Unit, 8x10x50' Single Pole Mast, Mounted on FWD Truck.

#516—Franks Model E.T. Single Drum Servicing Unit, 8x10x62' Single Pole Mast, Mounted on 1941 KB-F International Truck.

#526—Franks Super East Texas Double Clutch, Single Drum, Mounted upon KS-11 International Truck. No Mast.

#541—Franks Model ET Single Drum with 8x10x62-ft. Mast, Mounted upon 1948 Model KB International Truck.

#517—Type 3 O.C.S. Servicing Unit mounted on 1942 Mack Truck. Located Odessa, Texas.

#525—50/60 Ideco Skid Servicing Unit. Double Pole Mast. Mounted on International Tandem Truck.

#533—Cardwell KL Double Drum Spudder with 60 ft. derrick.

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TULSA, OKLAHOMA

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CORE DRILLS, SPUDDERS, ROTARIES: New and used equipment. Everything in supplies. Fishing tools rented. Pressey & Son, Pueblo, Colo.

FOR SALE: 1—Beaird—Ingersoll-Rand packaged Compressor Plant, Type 6-JVG (165 H.P.) Heavy Duty, direct connected, 4-cycle, gas engine driven, single stage equipped with 3—4¼ x 9 compressor cylinders, three hand operated fixed volume pockets, two hand operated valve lifters, 20" O.D. 500# W.P. intake scrubber, air starting equipment and controls for automatic operation. Designed for intake pressure range 100#-250#, discharge pressure range 500#-600#. Delivery 3,480 MCF per day at 250# intake, 550# discharge. This plant has been in use less than 30 days and is located near Palestine, Texas. Box H-616, The Oil and Gas Journal, Tulsa, Oklahoma.

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1 Caterpillar generator, A.C., 15 K.W.
1 Century generator, D.C., 10 K.W.
1 General Electric generator, D.C., 10 K.W.
1 Westinghouse, D.C., 10 K.W., generator.
1 Kohler electric plant, D.C., 1½ K.W., 4 cylinder.
1 Kohler electric plant, D.C., 5 K.W., 4 cylinder.
1 Kohler electric plant, 5 K.W., Waukesha motor, F.C.-140.

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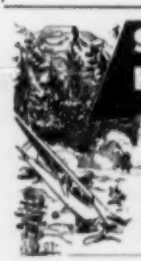

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1—Used Model O Cardwell drawworks complete with hydramatic brake, automatic catheads and powered by three 6WAKU Waukesha engines. Lovington, New Mexico.
1—Used Model O Cardwell drawworks complete with hydramatic brake, automatic catheads with two engine compound but less the engines. It can be powered with NK or LRO Waukesha engines. This rig is capable of drilling 8000'.
1—Used Wilson Giant drawworks complete with hydramatic brake, automatic catheads and powered by two GMC 671 twin engines. This rig is capable of drilling 7000'.
1—Used Buda engine, Model JL-1335. This engine is capable of pulling a 125 horsepower load satisfactorily.

All equipment in good usable condition and will bear inspection.

For Price and Location Call or Write

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FOR SALE—In Madison, Kansas district 3 Model GB Superior 2 cylinder vertical gas engines, 7½" x 8" with clutch, and 7 Model MC Weber 7½" x 9" DO. $350.00 each. These have been operating geared pumping units supplying water for waterflood. Cities Service Oil. Patridge, Bartlesville.

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5—600 HP IR Type KVG Gas Engine Driven 2 Stage Compressors (1942).
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$50,000 New Spare Parts for Above.
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TOWERS: 6'x58' chrome-lined (1951) 6'6"x65', 6'x27', 5'x27', 42"x49', 30"x38'.
HEAT EXCHANGERS: (2) 800 sq. ft. (675# 800° F.) Steel.
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PUMPS: BJ5-St. ni.-chr. pump, 2100' hd., 400 gpm.; IR 15x7x14 steam driven comp.
MISCELL.: Steel, chrome, pipe, valves and fittings, etc. NEW.

AT OTHER LOCATIONS

10—1500, 1000, 430, 360 sq. ft. Steel Ht. Exchangers.
5—850, 424, sq. ft. Adm. Ht. Exchangers.
3—RA-8, MA-4 Clark Gas Engines.
6—325# Vessels 10'x35', 7'x30', 4'x40'.
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8—715 sq. ft., 850 psig, 550° F., S.S.
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LINER FOR 5½ casing 1300' new 4" OD seamless 6" couplings 8 round thread 85c. M. J. Regan, Coffeyvile, Kansas.

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New spiral weld below warehouse price. Immediate shipment—subject to prior sale.

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200 SULLIVAN, truck mounted, 5 x 8 pump, $8,000.00. Mayhew 1000, $5,500.00. Box H-805, The Oil and Gas Journal, Tulsa, Oklahoma.

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American Can Closing Machine CANCO type 08-A, Fully automatic complete with feeder, motor, etc. Excellent condition. Crandall Two Spout Liquid Filling Machine, complete with scales, automatic shutoffs and motorized steel conveyors, both are ready to be placed on the production line without any additional parts. Box H-798, The Oil and Gas Journal, Tulsa, Oklahoma.

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WANTED: 3 or more miles of 6" invasion or spiral weld line pipe. Light weight 6⅝" O.D. acceptable. Green Pipe & Supply Co. P. O. Box 1383, Tulsa, Okla.

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WANTED: Junior Petroleum Reservoir Engineer having 2 or 3 years experience. Location of employment, Tulsa, Oklahoma. Give qualifications, references and salary expected in first reply. Our employees are aware of this ad. All replies will be held confidential. Box H-785, The Oil and Gas Journal, Tulsa, Oklahoma.

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Box H-787, The Oil and Gas Journal, Tulsa, Oklahoma.

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Please address Anderson-Prichard Oil Corporation, Liberty Bank Building, Oklahoma City, Oklahoma. Attention: Mr. D. F. Tver, Industrial Relations Department.

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Refinery process engineering assignments include design, control, economic studies and/or scheduling of operating programs.

QUALIFICATIONS: Age 25 - 38, engineering degree and several years professional experience in oil industry. Consideration can be given to United States citizens only.

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Commonwealth Oil Refining Co. Inc.
161 East 42 Street
New York 17, N. Y.

HELP WANTED

HELP WANTED

THE STANDARD OIL COMPANY (OHIO)

Manufacturing (Refining) Department

is looking for

CHEMICAL ENGINEERS, CHEMISTS, and MECHANICAL ENGINEERS

with one to five years experience in petroleum refining or related activities
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Possible employment in Toledo, Lima, or Cincinnati, also.

Applicant should have the following educational background and industrial experience:

CHEMICAL ENGINEERS: B.S. or higher degree and experience in development, pilot plant operation, process design, process trouble shooting, refinery process engineering, economic studies, or related work background.

CHEMISTS: B.S. or higher degree and experience in product and process research or development.

MECHANICAL ENGINEERS: B.S. or M.S. degree and experience in process equipment construction, design, inspection, or maintenance, petroleum product testing and field evaluation, or related work background.

Age Range 22 - 32

Salaries commensurate with experience and level in organization. Advance on merit basis.

If you can qualify and are looking for a permanent job with a growing but secure midwest company, write, giving full information on education, industrial experience, military experience, and personal data to

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SALESMAN for Houston area. Must be familiar with drilling equipment and know local contractors. Excellent opportunity. Replies will be held confidential. Box H-781, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST of outstanding ability, under 35, with at least 3 years' experience in northern Louisiana, gulf coast, and west Texas areas. Exploration and development experience essential for Dallas office of established independent oil concern. P. O. Box 2775, Dallas, Texas.

IMMEDIATE OPENING for graduate engineer desiring sales work. Home office location, Tulsa, Oklahoma. Give complete resume of experience, references, and salary expected in first reply. Box H-803, The Oil and Gas Journal, Tulsa, Oklahoma.

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Opportunity for varied experience in Dallas office of independent oil company. Recent college graduate, preferably with 1 - 2 years' experience. Draft exempt—not over 32. P. O. Box 2775, Dallas, Texas.

PETROLEUM GEOLOGIST

Wanted for position with independent oil company situated in Tulsa. Must be man of mature judgment with at least 5 years practical and successful oil finding experience in exploration and development. Should have administrative ability to organize and supervise company's exploratory activities. Salary will be commensurate with experience and abilities. In replying give complete personal and professional background and references. All applications will be treated in utmost confidence. Personal interviews will be arranged if data furnished meets our requirements. Box H-788, The Oil and Gas Journal, Tulsa, Oklahoma.

SOUTH AMERICA. Major Oil Company. Our fee paid. Mechanical Engineer - Petroleum Engineer, Producing or Drilling - Chemical Engineer - Geologist (must be single)—All requiring Degree, experienced or inexperienced. Mud Technician - two or more years' experience, single. Tool Pusher, three years experience. Foreman Pump Station, three to five years experience. On all jobs age limit is 40. All information confidential. Contact CHAS. J. LOVELESS PERSONNEL SERVICE, 616 S. Main, Tulsa, Oklahoma—Phone 4-3193.

PROCESS ENGINEER with thorough technical training and background of engineering and operating experience with special emphasis on catalytic and thermal reforming, alkylation and petrochemicals. Send complete record of education, experience, and minimum salary expected. Write Box H-723, The Oil and Gas Journal, Tulsa, Oklahoma.

GENERAL MANAGER for integrated oil company in South America. Prefer geological or petroleum engineering background with college degree and experience. Must also be a capable administrator and supervisor. Salary commensurate with experience and qualifications. Send detailed personal history and work experience to Box H-795, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST

Independent oil company has opening June 1 in Tulsa office for qualified sub-surface geologist. Must be familiar with Mid-Continent Area, particularly Oklahoma, and be capable of handling geological operations at divisional level. Age limit 40. Excellent position for right party. Give complete past employment record and educational background. All replies confidential. Box H-804, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

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GEOLOGICAL, MAP, Engineering Draftsman Major Oil Co. and Government Experience. Desires farm-out work only. Maps, Well logs, Engineering Drgs., Bulletin lettering. Lois Caldwell, 1031 No. Quaker, Ph. 3-0488. Tulsa.

PETROLEUM ENGINEER, Masters degree, 30, married, family, seven years Latin America. Workovers, well completions, reservoir studies, water and gas injection. Employed. Box H-786, The Oil and Gas Journal, Tulsa, Oklahoma.

REFINERY MAINTENANCE ENGINEER, equipment inspector. Over 7 years experience, incl. 4 years foreign, working with equipment in many phases of refinery operation. Desire oil company or refinery construction work. Graduate engineer. Speak Spanish. Will consider foreign employment. Box H-784, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST, 6 years South Texas experience desires new affiliation. Box H-791, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGICAL ENGINEER, 29, M.S. Geology, B.S. Mechanical Engineering (Petroleum Production Option). 4 years Geological and Production Experience with Major Company in Kansas and Oklahoma. Desire Position with Independent. Box H-755, The Oil and Gas Journal, Tulsa, Oklahoma.

MECHANICAL ENGINEER, age 33, with 5 years refinery and 7 months construction experience, desires change in location. References and detailed information on request. Box H-799, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER presently employed in supervisory position major company desires opportunity in operational-management field. Broad experience includes 9 years production, 4 years construction, and 4 years seismograph operation. Age 41, excellent references. Box H-797, The Oil and Gas Journal, Tulsa, Oklahoma.

GRADUATE Petroleum Engineer with 23 years experience in Okla., Kansas, Texas, and Illinois as Engineer, Production Superintendent, and Production Manager. Box H-802, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOPHYSICAL SUPERVISOR, 35, graduate, 13 years major company experience in Colombia and Venezuela. Employed. Desires foreign employment with chance for advancement. Prefers major company work in Middle East or Africa. Box H-794, The Oil and Gas Journal, Tulsa, Oklahoma.

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PIPELINES ANNOUNCED: Projected pipelines indicate increasing action in central Williston Basin, where we specialize in royalties in major company blocks. For informative material, write LANDOWNER ROYALTIES COMPANY, Box 1225, Great Falls, Mont.

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NEW OIL-FINDING METHODS
Two petroleum geologists, major companies, desire establish exploration office Rocky Mountains. Will employ new exploration methods based on overlooked and poorly understood laws governing petroleum accumulation. Overall integration of new methods can: (1) discover much oil and gas complexly trapped at shallow and medium depths; (2) often eliminate geophysical work; (3) reveal excellent prospects in both untested and "dead" areas; (4) prevent drilling of many worthless prospects. New horizons lie ahead. If you can help us, we think we can help you. Box H-793, The Oil and Gas Journal, Tulsa, Oklahoma.

EQUIPMENT MEN

Franklin Announces Three New District Managers

W. A. CARROLL

Promotion of three new district managers of Franklin Supply Co. has been announced by Jene Harper, Franklin president, Chicago.

William A. (Bill) Carroll, formerly Tulsa district manager, has been appointed district manager for Oklahoma and Kansas, with offices in Tulsa.

James E. (Ed) Farrell was named district manager of South Texas, Texas Gulf Coast, and Louisiana. He was formerly Houston district manager. District offices are in Houston.

District manager of East, North, Central and West Texas is Robert (Bob) Brewster, formerly district manager of

J. E. FARRELL

R. BREWSTER

Oklahoma City. District offices are in Dallas.

Franklin maintains Mid-Continent and Southwest stores and offices in Tulsa, Oklahoma City, and Ratliff City, Okla.; Odessa, Houston, Dallas, and Abilene, Tex.; and Morgan City, La.

Ethyl Corp. Realigns Sales Organization

A realignment of the sales organization of Ethyl Corp., which will improve and expand the company's services to the oil industry, has been announced by Malcoln P. Murdock, vice president in charge of sales. The organizational changes follow the formation of Ethyl Corp. of Canada, Ltd., which will direct the manufacture and marketing of Ethyl antiknock compound throughout Canada.

Under the new plan, Murdock announced, two new positions have been created. S. T. Pruitt has been named domestic sales manager, and will have charge of all domestic sales of antiknock compound. Harold R. Berg will assume new duties as sales coordinator.

In other departmental promotions, Stuart Forbes succeeds Pruitt as manager of Ethyl's central region, Leonard L. Huxtable has been named assistant manager of the southern region, and Laurence Reis has been appointed district manager of the Tulsa office.

Sewell Elected as Garlock Packing Vice President

J. B. SEWELL

J. B. Sewell was elected a vice president of the Garlock Packing Co., Palmyra, N. Y., at a recent meeting of the directors.

Sewell started with Garlock of Canada in 1935 as a sales representative in the Montreal area. In 1947 he was elected vice president of the company with headquarters in Montreal. In 1951, headquarters of the Canadian affiliate were moved to Toronto and Sewell moved too.

In 1954 Sewell was transferred to the United States and appointed general sales manager of the parent company with over-all direction of sales both in Canada and the United States. As vice president he will continue directing sales operations of the company.

Hughes to Manage Reilly's Dallas Sales Office

Henry D. Hughes has been placed in charge of the Reilly Tar & Chemical Corp. sales office in Dallas, it has been announced by J. R. Barnett, Jr., general sales manager.

Hughes has been engaged in the water and sewage construction business and has been associated with the Farquar Co. Prior to joining Reilly, he was managing his own oil and gas-producing and operating organization.

LEGAL

SEALED BIDS will be received until 2:00 P. M., Mountain Standard Time, May 25, 1955, and opened at that time in the Office of the Fort Peck Indian Agency, Poplar, Montana, for the leasing of 14,180.70 acres of Tribal land and 52,339.51 acres of allotted Indian land, located in Roosevelt and Valley Counties, Montana, for oil and gas mining purposes. The details of the lease offering and how and where to file bids may be obtained by addressing the inquiry to the Superintendent of the Fort Peck Indian Agency at Poplar, Montana, or telephone, Poplar, 2181.

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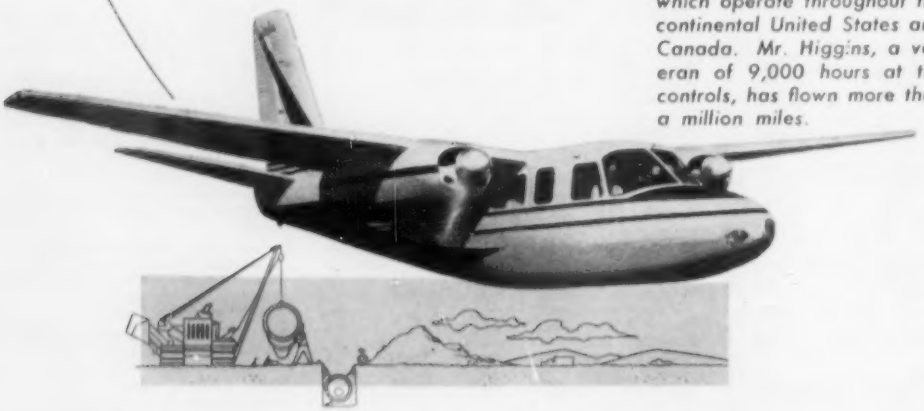

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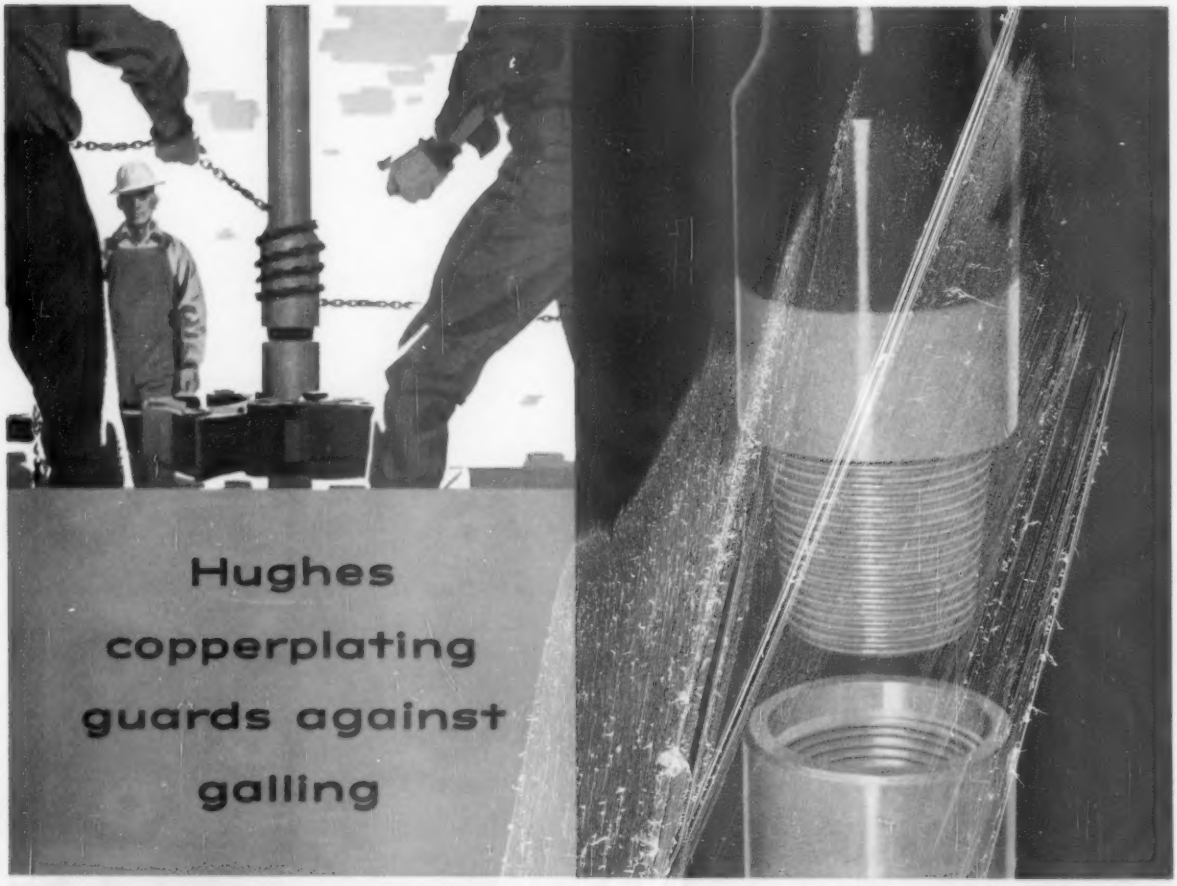

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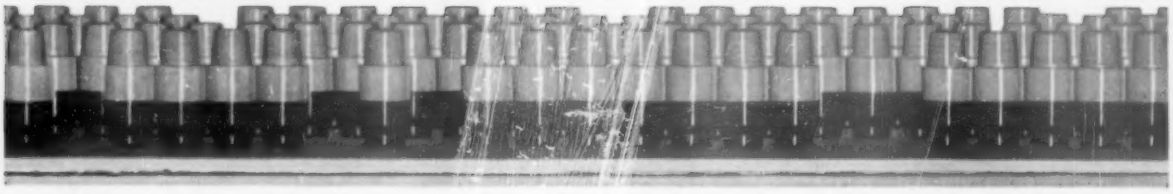

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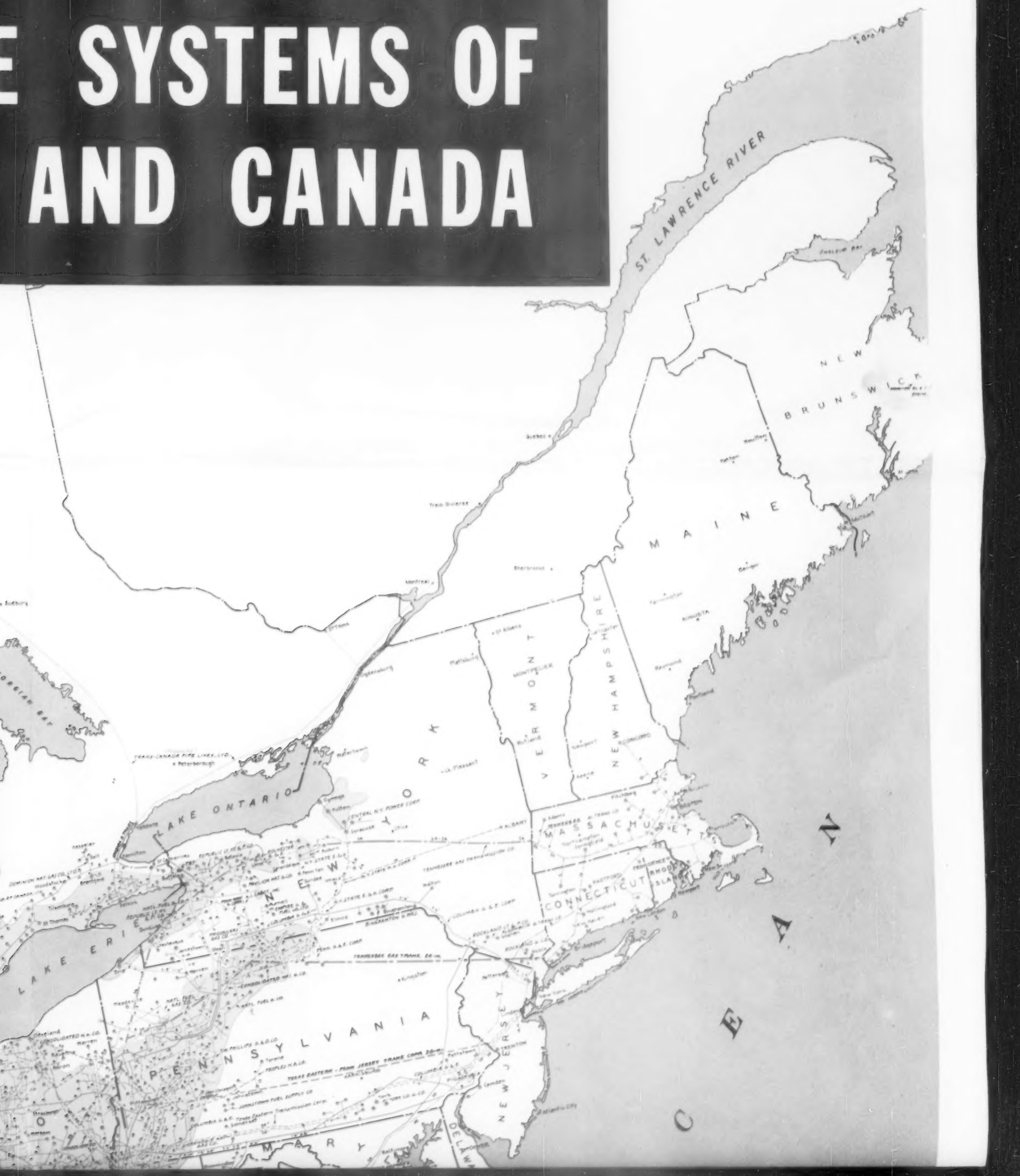

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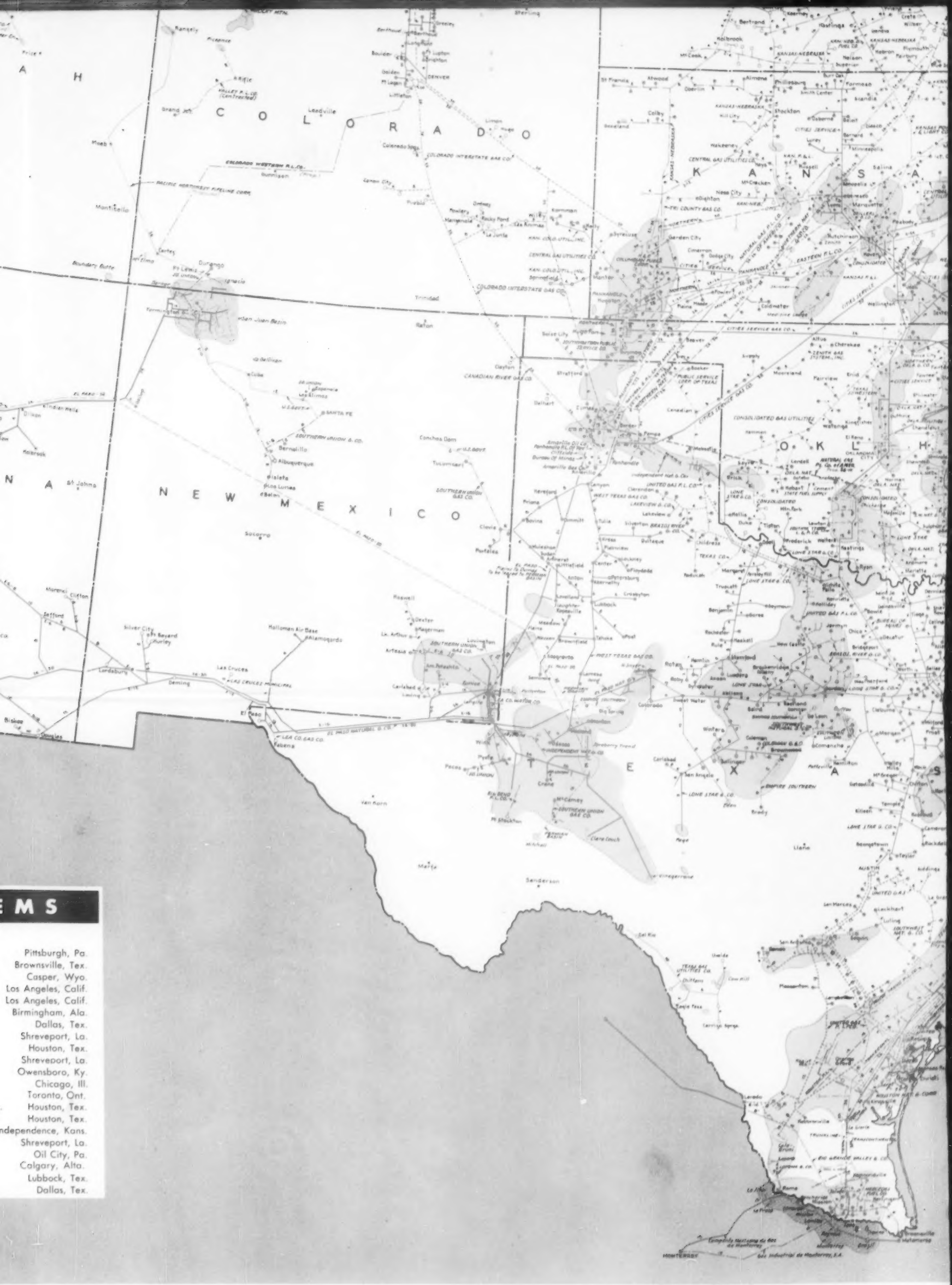
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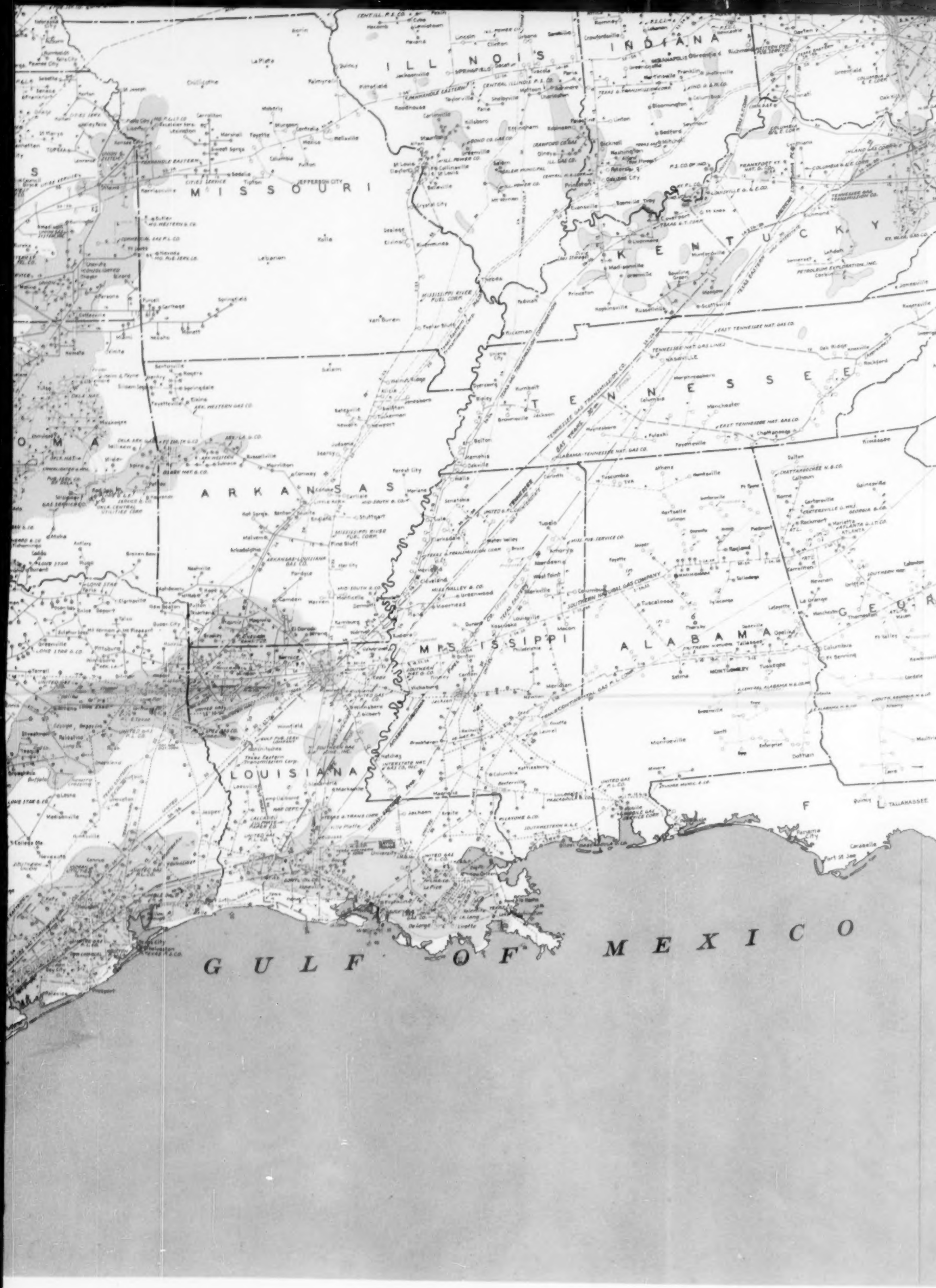
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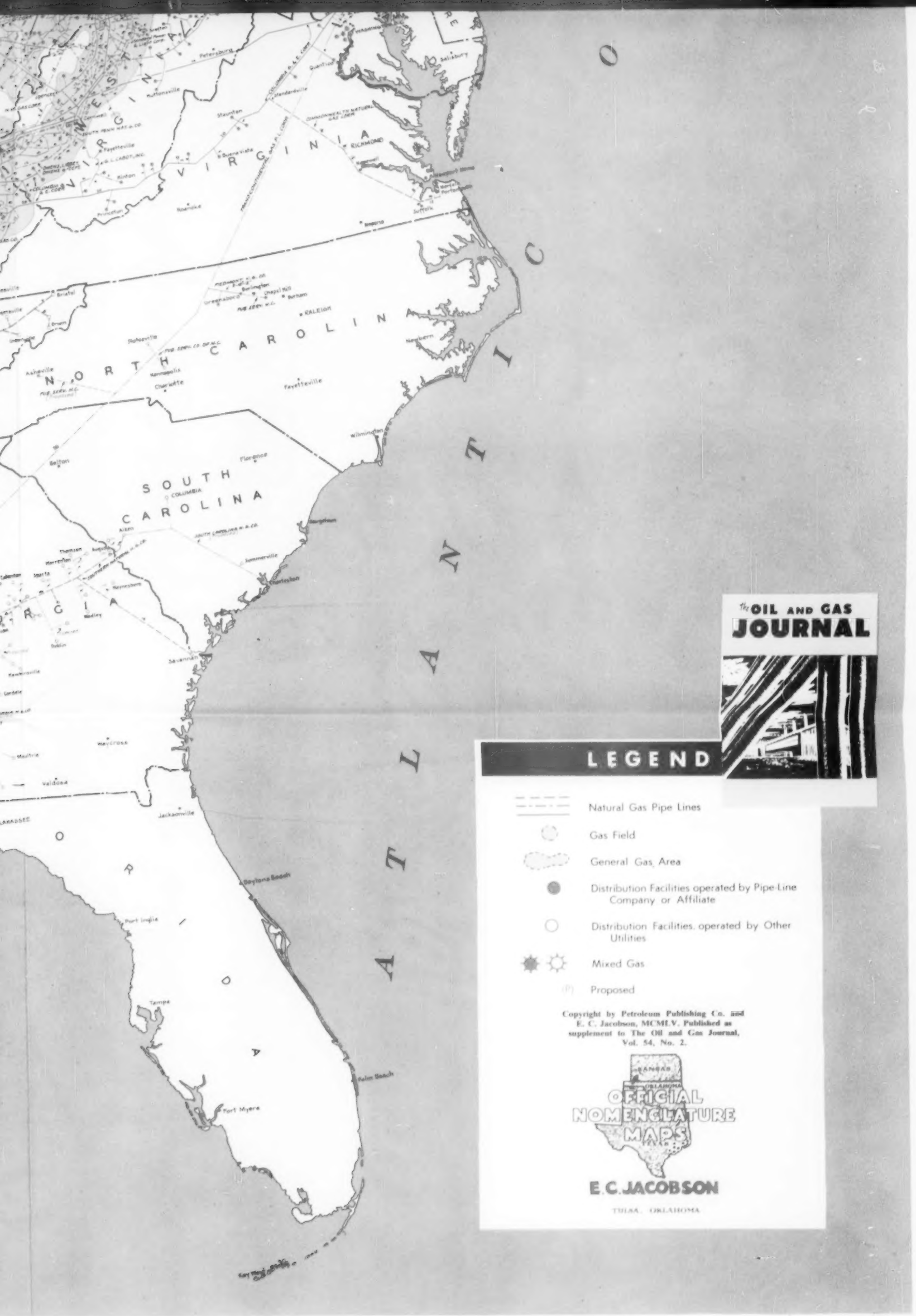

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LEGEND

- Natural Gas Pipe Lines
- Gas Field
- General Gas Area
- Distribution Facilities operated by Pipe-Line Company or Affiliate
- Distribution Facilities operated by Other Utilities
- Mixed Gas
- (P) Proposed

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E. C. JACOBSON

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